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An Expert System for Managing Storage Space Constraints
Aboard United States Naval Vessels

by

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Procedures for determining net stowage capacity and material configuration were reviewed to provide the user with an understanding of how to effectively utilize the expert system for developing a loadplan. The expert system includes a series of LOTUS spreadsheets to be used in conjunction with the Military Traffic Management Command's Computerized Deployment Sytem (CODES).
The study concludes that the use of an expert system would provide valuable assistance to the afloat Supply Officer and recommends further research to establish the CODES interface.

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An Expert System for Managing Storage Space Constraints Aboard United States Naval Vessels

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ABSTRACT

This study was conducted to determine if an expert system could be designed to assist the afloat Supply Officer in considering space constraints when developing a deployment loadplan.

Forecasting and Operations Research Models are used in the development of the expert system and adapted, as necessary to accommodate supply management afloat. Procedures for determining net stowage capacity and material configuration were reviewed to provide the user with an understanding of how to effectively utilize the expert system for developing a loadplan. The expert system includes a series of LOTUS 123 spreadsheets to be used in conjunction with the Military Traffic Management Command's Computerized Deployment System (CODES).

The study concludes that the use of an expert system would provide valuable assistance to the afloat Supply Officer and recommends further research to establish the CODES interface.

C.1

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I. INTRODUCTION

A young, Supply Corps Lieutenant reports onboard a tender as the Stores Officer for the S-1 Division. During initial inspection of the storerooms the Chief Storekeeper opens the largest bulk storeroom where he points out several large repairables located on the second and third shelf racks. Boxes of paper, rags and other lighter weight consumable products are double-stacked in front of the racks on pallets on the deck and personnel have to crawl over this material to check the markings on the material stowed in the racks.

The Chief explains that some years ago the division owned an electric forktruck which was why the repairables were loaded in the upper racks. He also states that if he had to issue one of the repairables he could make the issue if the riggers can figure out a way to maneuver the material out of the location but only after removing most of the material from the deck.

The Chief explains that the consumable materials were loaded prior to the last deployment from additional stock held in three warehouses on the pier. Items, such as xerox paper and the TDU weights used by the submarines for disposal at sea, were in constant demand and he wanted to be sure there

were sufficient quantities on hand to satisfy all requirements.

The Chief finally mentions there is a problem with routine flooding in the storeroom and while the water level has never risen above the pallets, no one knows where the water is coming from. When the young Lieutenant points out the boxes of oxidizing material in another corner of the storeroom, he admits the flooding is a problem since the oxidizers need to be stored in a dry space and for the paper products stowed on pallets on the deck.

The young Lieutenant and the Chief leave the storeroom in agreement on the need for a new storage loadplan which considers ease of issue and hazardous material storage. The young Lieutenant writes a reminder in his notepad to ask someone from the rigger's shop to come down and look over the situation. The Supply Officer had stressed the importance of supporting submarine refit as well as resupply. Failure to provide a critical part could prevent the submarine from meeting its operational commitments and it would not reflect well on his record if that critical part was on one of those racks and could not be issued.

The young Lieutenant also wonders about the safety hazards involved with overstocking the storeroom for a deployment and how the Chief determined which items to overstock. An

unpleasant picture forms in the young officer's mind on what the storeroom must have looked like before the deployment and he can hardly wait to see the other 48 storerooms.

With three full warehouses on the pier, the young Lieutenant knows Stock Control is not going to be able to tell him what quantities of specific materials to load for a deployment and there is still the problem of where the materials should be located. Without a computer to help figure it out he knows he will have to guess just like the Chief did.

When the young officer queries the current computer system, he is able to determine the following:

- Onhand Quantity (total quantity in all locations),
- Requisitioning Objective - High Limit,
- Reorder Point - Low Limit,
- Allowance and Load List Quantities,
- Locations 1-4,
- Various Management Codes (e.g.: Shelf Life Code, Shelf Life Action Code, Security Code),
- Demand History.

With all of these variables to consider, how to organize all of the information necessary for determining the best deployment loadplan for each storeroom is a very difficult process. What is needed is a computer program which has been

designed to consider all of these variables and the storeroom layout. Without one, the Stores Officer must resort to pencil and paper and hope for the opportunity to work it all out before the next deployment.

In a shipboard environment, the number and size of the storerooms may suggest there will not be a problem storing material; however, proper storage management procedures are more complex than just finding an empty bin or rack to place material in. There are a multitude of considerations which include but are not limited to whether or not the material is:

- flammable, corrosive, radioactive;
- a Coordinated Shipboard Allowance List (COSAL) item, a Depot Level Repairable (DLR), an item categorized as Controlled Material;
- an item which requires storage in an air conditioned storeroom, on the weatherdecks, in a storeroom with a fixed CO2 system;
- a fast mover, a slow mover, or war reserve stock.

Preparing an effective loadplan which adequately balances the ship's requirements against limited space constraints is critical to both inventory accuracy and supply effectiveness. If the material can not be found or is inaccessible, then the loadplan is ineffective. To determine the quantities to safely and adequately balance the ship's requirements against available storage is virtually impossible to do successfully.

It is impossible to do manually since there are too many variables to be considered.

The ship's mission is another variable to consider in preparing a deployment loadplan. United States naval vessels can be categorized as combatants or auxiliaries. A combatant will carry an allowance list of parts required to support the ship's equipment and crew. The range and depth for the allowance list is based on demand history. An auxiliary is a Combat Logistics Force ship such as an oiler, a submarine or destroyer tender, a repair ship or a fleet issue ship. Since it is impractical for a combatant to store quantities sufficient to satisfy normal demand to last throughout an entire deployment period and overstocking the storeroom can lead to unsafe storeroom stowage practices, the auxiliary carries a load list of materials required to back up or resupply allowance list material carried by the combatant. Load lists are based on historical demand data, information from the Inventory Control Point files and technical overrides which establish a minimum quantity for a new or critical item. [Ref. 1:p. 4-1 - 4-56]

A combatant will rely upon the auxiliaries in the battlegroup for regular resupply. These auxiliaries will then pull into port periodically to replenish their stock. An auxiliary such as a tender, on the other hand, may steam

independently and be required to have material on hand for a minimum of 60 days without resupply.

On a large combatant or auxiliary, like a tender, the range and depth of materials to be considered can be overwhelming. The Stock Control Officer and the Stores Officer are both responsible for inventory management of well over 75,000 line items. Together they use a variety of means to control the size of the inventory, such as:

- turn-in excess materials to the nearest Navy Stock Point,
- shelf-life management programs,
- perform periodic stock level setting,
- management of non-demand based stock assets,
- the reordering process.

Of the above, the reordering process has the most significant impact on the manageability of the inventory.

In general terms, the reordering process for stock replenishment consists of a review of the items carried in stock and the subsequent submission of the replenishment package or replenishment cancellation. The reordering process varies depending on the different computer systems available in the fleet and the guidelines established for the frequency of a reorder. Each computer system identifies the items for

review where the available stock assets are less than the requirements reflected in established stockage objectives.

Reviewing a replenishment package can be an insurmountable task, depending on the size of the reorder and the amount of time allotted for review. The process can become even more complicated on a tender, where the Stock Control Officer and the Stores Officer have different sets of rules and considerations influencing their decisions for the reordering of material carried in stock. The Stock Control Officer is generally concerned with the repercussions of material not in stock and the Stores Officer is more concerned with safe stowage practices. The Stock Control Officer can easily access the computer to determine the demand history, allowance quantities, number of substitutes or any other pertinent data which may influence the reorder decision. The Stores Officer generally has to rely on experience since the majority of materials carried in the supply system are not identified by cubic dimensions and the computer only identifies the location number(s) and not the size of the location(s). Experience is never infallible and is sometimes learned too late to avoid disaster and in the Navy, experience transfers every two to three years.

The Supply Officer, the Cargo Officer or the Stores Officer who is responsible for a single storeroom containing

over 18,000 line items or 75,000 line items in more than 40 storerooms needs a computer program to prepare an effective loadplan for inventory management. A computer program which balances the ship's needs against limited space constraints can be an effective management tool for determining when a specific reorder quantity can be considered reasonable, improving inventory and location accuracy, and providing stowage statistics for new construction storerooms.

The scope of this thesis is to explore the feasibility of designing and using an expert system to assist the Supply Officer, the Cargo Officer or the Stores Officer in determining the ship's space limitations and in preparing a ship's loadplan. Chapter II focuses on an explanation of expert systems and identifies its important impact on developing an effective loadplan. Chapter III provides the basic features of the retail consumer and intermediate inventory models used by the Navy Supply System and identifies applicable forecasting and operations research models to be used in developing a successful loadplan. Chapter IV reviews space management and space utilization techniques to be considered when developing a loadplan. Chapter V explains how to use the expert system and identifies significant limitations. In conclusion, Chapter VI provides areas for further research and a few summary comments.

II. BACKGROUND

A. WHAT IS AN EXPERT SYSTEM?

An expert system is a computer system which uses decision-making or problem-solving methodologies on specific knowledge to render advice or make recommendations. The decision-making or problem-solving methodologies can be represented as a set of rules to follow or it can be represented as a model of how something is supposed to work or be done. Expert systems can be very complex systems which go beyond simple problem-solving to explaining the solution and learning from the experience. [Ref. 2:p. 424-427]

The knowledge or set of rules is stored in the computer in a knowledge base and the computer is programmed to use that knowledge to solve problems by symbolic reasoning. The knowledge is generally stored in an If-Then format and the expert system manipulates symbols to solve problems. In addition to symbols, mathematical equations can be used. An expert system can also explain and justify its recommendation. [Ref. 2:p. 428-443]

Expert systems can either be large systems or micro-based small systems. There are many different problems which can be addressed by an expert system. They can also be designed to

solve one or more problems. One expert system may infer consequences from specific situations including predictions and forecasts. Another expert system may develop short-term and long-term plans to achieve goals or diagnose a problem and then develop a plan to correct the problem. Expert systems will generally [Ref. 2:p. 436-447]:

- interpret
- predict
- diagnose
- design
- plan
- monitor
- debug
- repair
- instruct
- control

Developing an expert system for solving problems is practical only if it solves more problems than it creates. For instance, if the expert system is manipulating data from another computer system, then it would be impractical to directly input all of the data from one computer to another manually. An expert system should [Ref. 2:p. 427-435]:

- be developed for an important task,

- preserve human expertise,
- be used in many locations,
- be necessary,
- improve the quality of performance.

B. HOW CAN AN EXPERT SYSTEM BE USED BY THE AFLOAT SUPPLY OFFICER TO BETTER ORGANIZE HIS STOREROOMS?

An effective loadplan is essentially a large knapsack problem. For example, a hiker can carry up to eleven pounds of food in his knapsack. He must select among four items with the weight and utility identified in Table II-1:

TABLE II-1

Item	Weight per Packet	Utility per Packet
A	1	2
B	2	5
C	3	6
D	4	12

The hiker would like to maximize his total utility subject to the constraint on total weight and the restriction for selecting full packets. He could select eleven packets of item A for a total utility of 22, but he can not choose three

packets of item D for a combined weight of 12 pounds. The problem could be written as follows:

- z_1 = number of packets of item A
- z_2 = number of packets of item B
- z_3 = number of packets of item C
- z_4 = number of packets of item D
- max $2z_1 + 5z_2 + 6z_3 + 12z_4$
- s.t. $1z_1 + 2z_2 + 3z_3 + 4z_4 \leq 11$
- $z_1, z_2, z_3, z_4 \geq 0$ and integer

Which items should the hiker take in his knapsack? [Ref. 3:p. 717-719]

This is an integer programming model. An integer programming model which includes all of the variables for number of line items, number of locations and categories of material would be an extremely difficult NP-complete problem to compute. An NP-complete problem is,

> "a class of decision problems for which it is easy to check the correctness of a claimed answer, with the aid of a little extra information. So we aren't asking for a way to find a solution, but only to verify that an alleged solution really is correct."[Ref. 4:p. 183]

Considering the number of variables involved, such as the number of line items, material configuration, material classification and stowage capacity, this polynomialtime

algorithm could not be solved in our lifetime. [Ref. 4:p. 178-188]

If one large problem with a large number of decision variables is broken down into a sequence of problems, each with a smaller number of decision variables, the problem is then easier to solve. The loadplan can be broken down into a series of steps as follows:

- determining the forecasted quantity required over a specified period of time
- identifying the desired quantity to be carried based on forecasting and available resupply
- obtaining optimal quantities through analysis of aggregate cubic requirements in relation to net stowage capacity
- assigning locations based on material classification and configuration

A series of LOTUS 123 spreadsheets can be used to forecast, identify material configuration, determine net stowage capacity and ascertain an optimal load quantity in relation to space constraints. The major advantages in using LOTUS 123 are:

- widespread use of this program in the Navy today,
- a database can be created for a program which accommodates a download from any of the computer systems currently used by the Navy Supply System,
- operations research models and equations used in creating the loadplan can easily be entered and protected in the spreadsheet.

A major disadvantage is the LOTUS 123 software limitations allow only a fixed number of line items to be manipulated at any one time.

Once load quantities, material configuration and location dimensions have been calculated and material and location classifications identified, the Military Traffic Management Command's (MTMC) Computerized Deployment System (CODES) can be used to create an effective deployment loadplan. MTMC designed the CODES program to enable the load planner to create an effective loadplan for break-bulk material, such as MILVANS, tanks and helicopters. CODES currently performs the following loadplanning functions [Ref. 5:p. 1-1 - 2-2]:

- Cargo Database Management
- Cargo Data Input
- Vehicle Marriage
- Weight Distribution
- Cargo-to-Compartment Selection
- Trim and Stability
- Templating
- Report Generation
- External Communications

The system uses a "master ship diskette (MSD)", which contains a database of ship characteristics for a specific ship.

Master ship diskettes are currently prepared and updated on all cargo ships for MTMC by the Transportation Engineering Agency (TEA). [Ref. 6]

By consolidating material requirements, configurations and classifications on one LOTUS spreadsheet, and providing location configurations and classifications on a second LOTUS spreadsheet, the CODES program would require only minor modifications to be used in preparing a combatant or auxiliary ship's loadplan. CODES provides the additional benefits of proven success and personnel experience. [Ref. 7]

While General Stores (GSK) is the primary area of interest, Aviation Stores, Ammunition, Ship's Store Stock, or Subsistence (Dry, Frozen, Chill) could be easily managed using the CODES program. The importance of working with cubic dimensions is it allows the necessary versatility to accommodate any type of material in any storeroom environment.

The value this expert system provides is largely dependent upon the set of rules stored in the knowledge base and the mathematical equations the computer is programmed to use to solve problems. The forecasting and operations research models to be discussed in Chapter III can be simplified as mathematical equations which can easily be accommodated in a LOTUS 123 spreadsheet. The set of rules stored in the knowledge base will be discussed further in Chapter V.

III. MODELS

A. MODELS USED BY THE NAVY SUPPLY SYSTEM

A discussion of the applicable forecasting and operations research models to be incorporated in the expert system is not easily understood without first reviewing the purpose and features of a few of the inventory models currently used by the Navy Supply System. Material requirements for the Navy fleet are computed based on retail consumer and intermediate inventory models. Retail consumer inventory models provide a tailored allowance list of materials for a combatant or an auxiliary ship based on the ship's equipment, the military essentiality of this equipment and the composition and size of the crew. Retail intermediate inventory models provide a load list of materials required on an auxiliary ship to back up or resupply the combatant's allowance list and support the ship's mission. These inventory models are primarily based on demand history. A brief synopsis of the objectives of the allowance and load list models appears in Tables III-1 and III-2. [Ref. 1:p. 4-1 - 4-56] [Ref. 8:p. 1-9]

The allowance or load list determination involves a very complex process of variable rule analysis and computation. While the models vary in complexity, a detailed explanation of

Coordinated Shipboard Allowance List (COSAL) - to provide a 90 day level of support for items which are components of, or provide support for, repairable equipment installed on the ship. The quantity carried in the COSAL is enough to meet forecasted demand with a 10% chance of stockout. These models include:

Fleet Logistics Support Improvement Program (FLSIP) Allowance Model - a fixed level model used on most ships.

Modified Fleet Logistics Support Improvement Program (MOD-FLSIP) Allowance Model - a fixed level model modified to increase the insurance stockage of specific items in the COSAL.

TRIDENT Allowance Model - a variable protection level model used for material specific to TRIDENT submarines.

WSS Model - a variable protection level model used for material specific to FBM and TRIDENT submarines.

Maintenance Criticality Oriented (MCO) Allowance Model - a variable protection level model used for material specific to FFG-36 through FFG-59.

Availability Centered Inventory Model (ACIM) - an optimization model experimentally used to compute allowance quantities for specific weapons systems.

Q-COSAL - nuclear items for nuclear powered ships and the tenders that support them.

Aviation Consolidated Allowance List (AVCAL) - to provide a 90 day level of support for repairable and consumable secondary items necessary to maintain assigned aircraft and support equipment.

TABLE III-1

ALLOWANCE LIST MODELS (CONT)

The quantity carried in the AVCAL is determined through analysis of system maintenance and reliability data.

Repairables Integrated Model for Aviation (RIM-AIR) Model - a pipeline model developed to satisfy the requirements of the DOD Retail Inventory Management and Stockage Policy (RIMSTOP) program in support of demand based items.

Optimized Allowance Requirement Register (ARR) Model - provides the quantities of items required to support aircraft subsystems as a function of aircraft flying hours.

LOAD LIST MODELS

Fleet Issue Load List (FILL) - to provide a 90 day level of support for Depot Level Repairables, Equipment Related consumables and Non-Equipment Related consumables used by combatants in either the Atlantic or the Pacific fleet. The quantity carried in the FILL is based on 24 months of combatant demand data received by the Combat Logistics Force units and other demand d a t a experienced at Navy Stock Points. Material designated in the FILL is identified as Prepositioned War Reserve Material Stock.

Tender and Repair Ship Load List (TARSLL) - to provide a 90 day level of support for repair parts and consumables required to support the repair mission of a repair ship and the repair and resupply mission of a tender. TARSLL's are either hull tailored, to support a specified set of hulls, or ocean tailored to support either the Atlantic or the Pacific fleet. The quantity carried n the TARSLL is based on demand data and configuration data from the Ships Parts Control Center's Weapons System File.

TABLE III-2

the Modified Fleet Logistics Support Improvement Program (MOD-FLSIP) Allowance Model is provided in Appendix A.

Allowance and load list requirements do not account for all of the materials carried on a particular ship. The Supply Officer has some influence over the range and depth of allowance and load list requirements and for the purpose of this thesis, these list quantities will be considered unchallengeable. Quantities carried in excess of allowance or load list requirements can present a problem when space is constrained. While load list requirements are for the most part predetermined by higher authority, requirements for additional stock is largely controlled through the reordering process. The reordering process varies depending on the computer system available aboard a specific ship, or in some cases, the lack of an available computer system. The Afloat Supply Procedures, NAVSUP Publication 485 provides extensive reorder guidelines for ships with Shipboard Non Tactical ADP Program (SNAP) II capabilities and manual operations. Appendix B describes the critical factors used in determining the stock limits which trigger replenishment on ships with SNAP I capabilities.

Once the allowance and load list quantities have been accounted for, the Supply Officer should be able to determine a satisfactory balance of additional materials by utilizing a few simple forecasting and operations research models. Models

which can provide an additional check and balance when reviewing the replenishment package and which can be used to improve location and inventory accuracy.

B. APPLICABLE FORECASTING MODELS

Forecasting models can be classified in a variety of ways. The four basic demand forecasting techniques discussed in this chapter can be classified as qualitative or quantitative. Qualitative models rely on opinion, experience and expertise. Quantitative models develop forecasts using historical data or association among variables. [Ref. 9:p. 38-40]

Solicitation of opinions, a subjective approach to forecasting, include [Ref. 9:p. 70]:

- interviews
- expert estimates
- market research
- collective opinions
- general surveys

Each method, approach or technique estimates future demand based on information provided by customers, wholesalers and retailers.

Quantitative models include Economic Indicators, Econometric Models and Time Series Analysis. Economic

Indicators and Econometric Models use the changing values of known indicators to predict turning points in a demand function. [Ref. 9:p. 71-75]

Economic Indicators depend on the interaction of two or more variables. In simple and multiple linear regression analyses, one or more independent variables is used to determine a dependent variable. Gross National Product (GNP) is a particular Economic Indicator which measures general economic activity. Economic Indicators are used more for product groups or aggregate dollar demand forecasts than for item-by-item forecasting. [Ref. 9:p. 71-74]

Econometric Models are usually a simultaneous set of equations that explain the interactions of variables involved in a business situation. Econometric Models can be [Ref. 9:p. 74-75]:

- Behavioral relationships, such as supply and demand curves
- Technical relationships, such as production functions
- Institutional relationships, such as taxes
- Identities, such as GNP

Time Series Analysis predicts future demand based on historical data. A number of components can influence the time series forecast [Ref. 9:p. 41-71]:

- level indicates the tendency of time series at any point in time

- trend indicates the rate of change in a series over time
- seasonal variation indicates an identifiable and repetitive annual pattern of movement above and below the trend line
- cyclical variation indicates a long term identifiable swing above and below the trend line
- random variation indicates an unusual swing above and below the trend line which can not be identified to a specific cause and has no distinctive pattern

Exponentially Weighted Moving Average (EWMA) or exponential smoothing is one of many Time Series Analysis techniques. The weight of historical data decreases geometrically as more weight is placed on recent data. There are a number of advantages in using the EWMA model. First, EWMA takes into account the error between the previous demand and the previous forecast. Second, EWMA uses an exponential smoothing constant to weight previous demand and the smoothing constant can easily be changed without adjusting the formulas. Third, EWMA can be used to accommodate trends, seasonal and cyclical patterns. While some Navy material exhibits seasonal demand patterns, most does not and cyclical patterns are of no concern in a short-term analysis. Fourth, EWMA can be used to project more than one period into the future and allows the forecaster to review specific timeframes within a broader perspective. Finally, EWMA is easily accommodated within a Management Information System. A major disadvantage which should be kept in mind when using the EWMA model, is

exponential smoothing can react slowly to dramatic changes in demand, depending on the value used for the exponential smoothing constant. [Ref. 9:p. 53-69]

The EWMA model with trend correction is a three part model. The formulas are provided in Table III-3 [Ref. 9: p. 57-60] with a brief definition of the symbols used to abbreviate the interpretation.

The current level is computed first and then the current trend. The exponential smoothing constant is usually between the range of 0.1 and 0.3. Small values place greater weight on historical demand conditions and have a greater smoothing effect. Large values put greater weight on current demand. The level and trend are then used to obtain the demand forecast. The process is then repeated to determine the demand forecast for the number of periods in question. [Ref. 9:p. 56]

While this single forecasting technique can not be superior in all cases, it is important to bear in mind that any forecasting technique used to predict change, is subject to change. Forecasting is also subject to error regardless of the technique selected. The forecasting techniques proposed in this thesis do not supersede available information, but can be used as an additional check on current demand patterns. EWMA forecasting results can augment the Supply Officer's judgement and experience in distinguishing between critical

EWMA WITH TREND

t = *current period*
$t-1$ = *last period*
T_t = *current trend*
T_{t-1} = *trend, last period*
X_t = *level*
X_{t-1} = *level, last period*
Y_t = *current demand*
Y_{t-1} = *demand, last period*
F_t = *forecast*
α = *exponential smoothing constant,* [0,1]
β = *exponential smoothng constant,* [0,1]

$$X_t = \alpha(Y_{t-1}) + (1-\alpha)(X_{t-1}+T_{t-1})$$

$$T_t = \beta(X_t - X_{t-1}) + (1-\beta)T_{t-1}$$

$$F_t = X_t + T_t$$

TABLE III-3

requirements, normal demand patterns and dead stock.

C. APPLICABLE OPERATIONS RESEARCH MODELS

Operations Research models are widely used in logistics, particularly since the 1970's with the expanded use of computer technology for mathematical and statistical modeling. A variety of models have been applied to the key and support activities:

Key	Support
Customer Service	Warehousing
Transportation	Materials Handling

Inventory Management	Acquisition
Order Processing	Protective Packaging
	Product Scheduling
	Information Maintenance

Some of the most widely accepted models are used for Customer Service, Transportation, Inventory Management, Product Scheduling, Information Maintenance and Warehousing. [Ref. 10:p. 1-23]

The simpler the model, the easier it is to use. Chapter II described an effective loadplan to be a large knapsack problem. The expert system must accommodates all of the variables and be easy to design and use. When the items carried in the loadplan are addressed as individual categories of material, the knapsack problem becomes more manageable.

Individual items in the knapsack can then be assigned specific weighted values or utility, which enables the Supply Officer to determine the relative importance of each of the items under consideration. On a tender, for example, the Stores Officer may be concerned with the optimal product mix of four different types of 5-gallon primer cans held in a single storeroom. One primer is primarily used by the tender's customers, a second is primarily for ship's use and the remaining two are held as suitable substitute items. The Stores Officer may want to place greater value on the primary

primers and lesser value on the substitutes. When these items are then reviewed in relation to one another and in view of the variable constraints for all the material held in this storeroom, the Stores Officer can make a more realistic decision on how the storeroom in question should be loaded.

For the purpose of this thesis, utility is not going to be considered a factor. Allowance and load list quantities will be considered first. The remaining space will be allocated to each of the line items based on the proportional relationship between the forecasted load quantity and available storage space. Whether or not the Supply Officer, Stores Officer or Cargo Officer chooses to add utility to convert this allocation process to a knapsack problem will be up to them.

The final step in preparing an effective loadplan is identifying the best location for each item carried onboard. An Operations Research model which can be used to help identify the best location for specific items is the Modified Distribution or Multiple Origin-Destination model. The Multiple Origin-Destination model provides a number of basic principles that can be applied to make the problem more manageable. When the problem is viewed as a matrix, where comparable weights are assigned to both material and locations, individual items cans be matched to the most accommodating locations available.

An effective loadplan may or may not be prepared by creating a dynamic programming model that accommodates all of the variables involved. A series of spreadsheets which assist the Stores Officer in determining material requirements, configuration and classification can be consolidated on a single spreadsheet and another spreadsheet can be used to identify storeroom location configuration and classification. The two spreadsheets can then be incorporated in CODES, which matches material to compatible locations. Material, location and storeroom configuration is discussed in greater detail in Chapter IV.

IV. AN EXPERT SYSTEM: VARIABLES TO CONSIDER

A. SPACE MANAGEMENT

In the last two decades there have been a significant number of innovations in stowing and retrieval systems for Navy and private industry warehouses. A recent study sponsored by the Office of Naval Technology (ONT) and conducted by the David Taylor Research Center, entitled "Small Combatant Stowage Systems Analysis," described and analyzed nine candidate stowage systems which could potentially increase stowage capabilities, require less manpower and satisfy safety and other concerns for shipboard use. The primary emphasis of the study was improving stowage for provisions, general supply repair parts and ammunition for the 5"/54 caliber gun on new construction ships. Evaluation factors are identified as follows:

- Use of Space is a measure of how well the system uses available volume to achieve stowage density.
- Stowage/Retrieval Time is an estimate of the time to store and retrieve material.
- Manning is the number of people required to operate the system, relative to the baseline system.
- Weight is the weight of the stowage system, not material, relative to the baseline system.

- Power is the ship power (electric, pneumatic, etc) required to operate the stowage system.
- RM&A is the reliability, maintainability and availability of the system.
- Cost is the cost to acquire and install the stowage system, relative to the baseline system plus the cost effect on the ship.
- Backup is the ability to perform stowage and retrieval operations if the system is inoperative (not available).
- Affects of Ship Motion is the ability of the stowage system to operate during high sea states.
- Adaptability is the ability of the stowage system to adjust to the ship and the crew to adjust to the system.
- Safety is a measure of the degree to which personnel who operate the stowage systems are not likely to be injured and material that is stowed in the systems is not likely to be damaged.
- Security is the ability of a stowage system to deter pilferage.
- Installation is the measure of the lack of difficulty to install the stowage systems.

The significant result of the study is the determination that only one of the nine candidate stowage systems offered potential improvement over current systems and only for general supply repair parts. [Ref. 11:p. 2-50, 67-68]

While modern technology appears to be making significant strides ashore, it would appear to be floundering afloat. Supply Officers can look forward to only minor changes in existing stowage systems aboard ships for the next twenty plus years. Personnel manpower, which was a primary concern in the

study conducted by the David Taylor Research Center, will become a more immediate problem for the Supply Officer.

> It is anticipated that future ships will have smaller crews. With smaller crews, less manpower would be available for manpower intensive tasks such as material stowage during a replenishment. Stowage operations must be examined now for systems and concepts to increase stowage capabilities for future small combatants. [Ref. 11:p. 2]

The Supply Officer's dilemma is further compounded by the following problems [Ref. 11:p. 13-14]:

- The Naval Supply Systems Command (NAVSUP), and its design agent Fitting Out and Supply Support Assistance Center (FOSSAC), determine stowage requirements (volume) but neither, to any great extent, participate in location determination or configuration of supply spaces on new ships nor serve as an advocate for stowage during the entire design process.

- The hull size is determined before equipment selection and manning are finalized, which sometimes results in a hull size which cannot accommodate stowage requirements.

- Once ships are delivered, spaces are sometimes swapped within the Supply Department or with other departments. Changes are often made without the approval of NAVSUP, NAVSEA, or even the TYCOM. Without the approval of headquarters, space changes are more likely to be made without analysis of their full impact on stowage capability. Such changes may degrade the stowage capabilities designed into the ship.

- Ship modification during overhaul sometimes reconfigures stowage spaces causing them to be less efficient. New equipment placed onboard ships often takes storeroom space without providing compensation for loss of stowage.

- Configuration of space and ship does not permit installation of proper stowage aids or material handling equipment. Manholes, pipes, vent, air conditioners and other structures quite often intrude into the stowage

compartment making stowage volume unusable as well as eliminating the use of certain types of stowage aids.

- Stowage aids available for repair parts storerooms do not allow for high density stowage. The stowage aids in some storerooms do not have adjustable shelving to allow for various size materials, causing loss of stowage space. Deck and/or overhead grating is not always installed in all provisions storerooms, preventing the use of telescoping battens. Without deck and overhead grating in the chill/freeze compartments, cooling coils are very susceptible to damage by material banging into them.

- Type commanders require ships to operate at higher endurance levels than specified in the ships Top Level Specifications or OPNAV Instruction 4442.1E.

The Department of Defense's "Storage and Materials Handling" publication (DoD 4145.19-R-1) describes storage space as a basic resource.

> Economy depends upon the optimum utilization of this space, and the proper arrangement of operations incident to the receipt, storage, and issue of materials. Space economy can be obtained only by thorough planning for the use of space. [Ref. 12:p. 2]

The Supply Officer, however, has very little control over either the number or configuration of storerooms. Thorough planning for the use of space is limited as follows:

> The number, locations, shapes, and sizes of supply department storerooms vary significantly in each type of ship. Therefore, each supply officer must carefully study the configuration and capacities of all available stowage spaces when determining the types and quantities of material to be stowed in each. The location storeroom doors, hatches, stanchions, ventilation ducts, overhead fixtures, and other structural aspects also must be considered in planning the stowage layout. Architectural 'obstructions' will be studied and altered when possible

> and as necessary, to create additional stowage space. [Ref. 13:p.4-72 - 4-73]

In addition,

> ...storerooms will be outfitted with bins, racks, shelving, lockers, drawer cabinets, deck gratings, battens and/or other stowage aids best suited for the types and quantities of materials to be stowed. When installed stowage aids need to be modified or relocated, or when additionally required stowage aids must be manufactured by a repair ship or shipyard, the supply officer will submit an appropriate work request to the ship's engineering officer... [Ref. 13:p. 4-73]

While optimum space utilization can be acquired through alteration or manufacture of storage aids, the benefits are long-term and of no immediate use to the current Supply Officer. The Department of Defense's "Storage and Materials Handling" publication (DoD 4145.19-R-1) provides the most useful solution to the current Supply Officer's problem.

> A storage area floor plan layout is an excellent management tool for space control. It enables planning for the effective use of space. [Ref. 12:p. 2-23]

A storage area "floor plan" layout can consider manholes, pipes, vent, air conditioners and other structures which have an impact on the volume of usable stowage space or the type of stowage aids to be used. [Ref. 12:p. 2-23] [Ref. 13:p. 4-73]

CODES, an expert system designed by the Military Traffic Management Command (MTMC), is currently the only available management tool to produce a "floor plan" layout which

considers all pertinent structures or ship characteristics. The ship characteristics for specific cargo ships are identified by the Transportation Engineering Agency (TEA) on master ship diskettes. The current system primarily focuses on the two dimensional aspects of length and width. Height is considered a factor for determining when items can be double-stacked. The diversity of material accommodated on most Navy ships requires a three-dimensional storage area "floor plan". A three-dimensional storage area "floor plan" would be an extremely effective management tool for capitalizing on the net stowage capacity available in storerooms with and without stowage aids.

B. SPACE UTILIZATION

Identifying the net stowage capacity available requires an understanding of the proportional relationship between storage dimensions and material configurations. On new construction ships, supply stowage capabilities are determined by the Naval Supply Systems Command (NAVSUP) and Fitting Out and Supply Support Assistance Center (FOSSAC). General Stock stowage is based on ship types with similar COSAL's, which considers what was actually designed, constructed and installed in the ship. Seventy five percent of the COSAL is allotted for bulk stowage, ten percent for medium stowage and fifteen percent for small stowage. If a ship with a similar

COSAL is not available, DDS 672-2 provides guidance for determining gross square feet and the number of stowage aids. Based on these computations, fifty percent of the storeroom is utilized on most ships, with somewhere between thirty to thirty five percent utilized on some smaller ships. [Ref. 14]

The net stowage capacity for a bulk storeroom or a bulk storage location can be obtained by measuring the length, width and height and applying the following formula:

L x W x H x UF = Net Stowage Capacity

(utilization factor - UF, is typically .5,

and use .35 for smaller ships)

If the measurements are in inches, divide the Net Stowage Capacity by 1728, twelve inches cubed, to convert to cubic feet.

To determine the net stowage capacity for a rack, bin or drawer, measure the inside length, width and height and apply the following formula and convert to cubic feet:

$$L \times W \times H \times PF = \frac{\text{Net Stowage Capacity}}{1728}$$

A packing factor (PF) must be considered for material stowed in racks, bins or drawers. The packing factor can differ depending on the type of rack, shelf or bin as follows:

- Type "A" and "B" drawer shelf units = .7
- Type "S" or "B" bin = .6
- Type "J" or "K" rack = .75
- MDS and SVMDS (Modular drawer cabinets) = .7

Table IV-1 provides a breakdown of net cubic feet for the most common bins, racks, cabinets and lockers used by the Navy and some specific dimensions for individual drawers, bins and shelves. [Ref. 11:p. 69-77]

Another feature which should be kept in mind when designing a "floor plan" layout is the aisle width. Aisles should measure at least thirty inches wide between bins, racks, and cabinets. The material carried onboard U.S. Navy ships is palletized packaged material and shelf or bin material. The Consolidated Afloat Requisitioning Guide Overseas (CARGO) NAVSUP P-4998 provides the net cube on a good number of the line items to be considered and can be used as a guide for determining similar material. Pallet load dimensions are normally 40 cubic feet which is defined as a Measurement Ton (M/T). One M/T equates to a standard cargo load 40" deep by 48" wide by 36" high, including pallet. The average storage pallet is 32 cubic feet, about 0.8 M/T, and equates to a load 40" deep by 48" by "28.8" high, including pallet. [Ref. 12:p. 2-25] [Ref. 15:p. 4-4]

NET STOWAGE CAPACITY

Stowage Aid	Net Cubic Feet
MDS Cabinet (Vidmar Model 340)	10.7403
SVMDS Cabinet (Vidmar Model SV-340)	7.6411
MDS Bin Storage	
Model S-135 (2 shelves)	5.7710
Shelf capacity	2.8855
Model S-155 (2 shelves)	6.4924
Shelf capacity	3.2462
SVMDS Bin Storage	
Model SV-S-135 (2 shelves)	4.2512
Model SV-S-155 (2 shelves)	4.7826
A Drawer Unit (72 drawers)	8.8956
Drawer capacity	0.1236
B Drawer Unit	13.8141
S Bin (18 drawers)	17.6249
Drawer capacity	0.9791
B Bin (36 inches wide)	21.6847
B Bin (24 inches wide)	14.4303
J Rack (4 shelves)	35.6501
Shelf capacity	8.9126
K Rack	42.5222
R Rack (4 shelves)	34.3518
R Rack (6 shelves)	32.2065
S Rack (4 shelves)	32.0866
S Rack (6 shelves)	31.9177
Alcohol Locker (4 shelves)	28.5201
Shelf capacity	7.1300
Flammable Medical Locker	4.2367
Flammable Liquids Locker	5.3478

TABLE IV-1

The proportional relationship between storage dimensions and material configurations provides the basis for creating an effective "floor plan" layout; however, the type of storeroom and the material classification are additional variables to be considered.

C. TYPES OF STOREROOMS AND MATERIAL CLASSIFICATIONS

The types of storerooms and material classifications can provide an overwhelming number of variables to consider for any mathematical equation. To accommodate all of the variables, the database should include data elements from the Basic Material File (BMF) to be used to identify material stow requirements for all of the special categories of material identified in Table IV-2. Material locations would also have to be classified for type of stowage so that with minor modification, the CODES program could assign specific materials to corresponding locations.

Chapter V explains how the expert system is organized, how to use the expert system and significant limitations.

TYPES OF STOREROOMS AND MATERIAL CLASSIFICATIONS

a. Number of Bulk Storerooms/Locations
b. Number of Binnable Storerooms/Locations
c. Gas Bottle Racks
d. Number of Hazardous Storerooms/Locations:
    (1) 1 gal. paint cans/spray cans
    (2) 5 gal. paint cans
    (3) Lube Oils cans
    (4) Lube Oil drums
    (5) Freon
    (6) Oxidizers
    (7) Acids
    (8) Corrosives
    (9) Flammables
    (10) Calcium Hypochlorite
    (11) Radioactive
e. Number of Controlled Material Storerooms/ Locations:
    (1) Small Controlled Materials
    (2) Large Controlled Materials
    (3) Controlled Bar Stock
f. Number of DLR Storerooms/Locations:
    (1) Small DLR's
    (2) Large DLR's
g. Number of Q COSAL Storerooms/Locations
h. Number of Pilferable Storerooms/Locations
i. Number of Medical Storerooms/Locations
j. Number of Custodial Locations:
    (1) Medicinals
    (2) Classified
    (3) Pubs/Forms
    (4) Alcohol
k. Number of Clothing Storerooms/Locations
l. Number of Sheet Metal/Bar Stock Storerooms/Locations
m. SUBMART
n. Number of Air Conditioned Storerooms/Locations (film, batteries, etc.)
o. Number of POS/POD Storerooms/Locations
p. Number of Computer Part Storerooms/Locations
q. Number of Other Storerooms/Locations

TABLE IV-2

V. AN EXPERT SYSTEM FOR MANAGING STORAGE SPACE CONSTRAINTS AFLOAT

A. FILE ORGANIZATION FOR SPACE MANAGEMENT

This expert system was developed on a 386 IBM compatible personal computer utilizing one megabyte of random access memory (RAM), two disk drives and a 67 megabyte hard drive. Drive A utilized 5¼ inch floppy diskettes while drive B utilized 3½ inch micro-diskettes. The commercially available software package LOTUS 123, Release 3.1, was the software chosen for this program.

The expert system is currently divided into nine spreadsheets as identified in Table V-1. Appendix D provides a detailed description of how each of the spreadsheets are organized. In the next section, the "User's Manual" describes how to create and use all of the spreadsheets. The final step, the interface with MTMC's CODES program as discussed in Chapter III, was not completed for this thesis.

B. USER'S GUIDE

In describing the User's Guide, the user is presumed to have at least a working knowledge of how to create, retrieve and save files, build and move about the worksheet, add and edit data, and create formulas.

File Name	Title/Function	Disk Number
C:\LOTUS\ MODULE1.WK3	Database: Identifies BMF data elements. Minimum bytes of storage required for 49 line items is 142183.	HD
C:\LOTUS\ DEMAND.WK3	Demand: Identifies BRF data elements. Enter monthly demand history for 12 or 24 months. Minimum bytes of storage required for 49 line items is 16890.	HD
C:\LOTUS\ FORCST2.WK3	Forecast: Historical Data: Determines the forecast if two years of demand data is available. Minimum bytes of storage required for 49 line items is 126262.	HD
C:\LOTUS\ FORCST.WK3	Forecast: Most Recent Data: Determines the forecast for 12 and 24 months of demand history. Minimum bytes of storage required for 49 line items is 144590.	HD
A:\MODULE2 .WK3	Computing Your Load Quantity: Projects the load quantity based on resupply and deployment time-frames. Minimum bytes of storage required for 49 line items is 8377.	1-12
B:\MODULE3 .WK3	Allocating Constrained Space: Identifies the specific quantities to be carried when space is a limiting factor. Minimum bytes of storage required for 49 line items is 33425.	13
B:\MODULE4 .WK3	Computing Material Configuration: Computes material dimensions and can be used to identify an appropriate storage aid for specific material configurations. Minimum bytes of storage required for 49 line items is 20823.	13
B:\MODULE5 .WK3	Review of Storage Practices: An optional database of pertinent material handling requirements.	14
B;\MODULE6 .WK3	Computing Ship's Configuration: Computes location dimensions and includes packing factor. The minimum bytes of storage required is dependent upon the number of locations on the specific ship.	14

TABLE V-1

One of the most difficult steps in using the LOTUS spreadsheets is setting up the database. A detailed description will be provided on "parsing", however the LOTUS 123 Handbook provides additional guidance on this procedure.

A description is also provided on how to create and use the MACROs which simplify processing procedures. Appendix D identifies all of the mathematical and logic formulas used in the spreadsheets, as well as the columns which link the various files.

When the user is "parsing" or initially organizing the various worksheets, it is strongly recommended that data be "parsed" in blocks of 100 rows at a time, and when copying, one column at a time, to expedite computer response time and to test system limits.

Once the spreadsheets are organized, the user is required to manually input data to some of the spreadsheets as indicated below; however, MACROs have been used as much as possible. Some of the formulas, file links and MACROs, discussed in Appendix D are programmed for 999 line items. For example, {MENU}RV{CE}D2..D1000~{CE}N2..N1000~, would copy the value created by the formula in blocks D2 through D1000 to blocks N2 through N1000. If the user can only manipulate 249 line items at any given time, then the appropriate formulas, file links and MACROs should be modified to the following

formula:

{MENU}RV{CE}D2..D250~{CE}N2..N250~.

1. Downloading Data to Your Database

A File Analyzer and Report Generator (FIANA) was used to extract specific data elements from the Shipboard Uniform Automated Data Processing System (SUADPS) files. The NAVSUP PUB 524 provides specific guidance on preparing the parameter worksheet and executing FIANA runs. The data was then downloaded to a 5¼ inch floppy diskette which was used to create C:\LOTUS\MODULE1.WK3, Database. The FIANA should extract the data elements, as identified below, for a maximum of 999 line items to be used to test your system capabilities. If your system can easily accommodate all 999 line items, you can incrementally increase the size of subsequent FIANA extracts to conform to your system capabilities.

The following BMF data elements are mandatory as identified by the Unit System Identification or USID (which identifies USID A: AFS, USID B: FBM Tender, USID C: CV/LPH/LHA and USID T: Tender) [Ref. 16:p. 59-63]:

- National Stock Number
- Locations 1-4
- COSAL
- MISC LOAD
- AVCAL (USID C)

- FILL ALLOW (USID A)
- NUWEPS ALLOW (USID B or T)
- BCOSAL (USID C)
- PKUP (USID C)
- OS ALLOW (USID B)
- LLQTY (USID T)
- FTLQ (if USID B)
- STLQ (USID B)
- FILL (USID A)

The data elements used by each of the USID's may vary depending on the individual unit or the acronyms may differ from the ones specified above.

The following BMF data elements are recommended:

- MCC
- UI
- Description
- ERC (EEC)
- SEC
- SLC
- SMCC
- TSC
- LMC
- AT
- ADPE

- PEB
- PMIC
- SPALT
- MSP
- REC
- IRC
- RO
- RP

The system capabilities will determine the disk drives the user is loading from and to. For the purpose of this discussion, the ASCII file containing the information from SUADPS was loaded in Drive A and MODULE1.WK3 was created on the hard drive. To create the database:

1. Call up the LOTUS 123 program and execute File/Import/Text. Clear the entry and type in A:\(filename) to retrieve the file (e.g. FIN.2). The FIANA parameters should appear in the top left corner of the worksheet as indicated in Figure V-1.

	A	B	C	D	E	F
1	AFD1	NPGS				
2	AFD2	SEL	2			
3	AFD2AI,091X01		3,			
4	AFD2BI,103406		50,			
5	AFD3SUB	MRF				
6	AFD3PTN004001018		034021005	06037030005	06055039005	
7	AFD3PTN091053001		095057002	103062006	109071006	
8	AFD3PTN136098005		06140107002	148112012	HDR	
9	A	NSN	MCCUI	COS	LL	FTLQ SECL

Figure V-1 FIANA Import

2. Delete all of the rows so that the column titles appear in the first row. The titles and other extraneous data may appear again further down in the worksheet, about every 27 rows. This data should also be deleted so that data on each NSN appears consecutively from rows 2 to 1000.

You are now ready to begin extracting data from the ASCII file:

1. Execute File/Extract/Formulas then clear the entry and type in C:\LOTUS\MODULE1.WK3. The system should respond more rapidly if you extract 100 line items at a time. The recommended range for C:\LOTUS\MODULE1.WK3 is rows 1 through 100.

2. Repeat the File/Extract/Formulas commands until all of the line items are processed and name each of the subsequent files by number. For example:

- Rows 1 through 100: C:\LOTUS\MODULE1.WK3
- Rows 101 through 200: C:\LOTUS\MOD002.WK3
- Rows 201 through 300: C:\LOTUS\MOD003.WK3
- Rows 301 through 400: C:\LOTUS\MOD004.WK3
- Rows 401 through 500: C:\LOTUS\MOD005.WK3

The subsequent files will be incorporated in C:\LOTUS\MODULE1.WK3 later, so numbering the files is purely a matter of convenience.

You are now ready to begin "parsing" data:

1. Retrieve C:\LOTUS\MODULE1.WK3. and move the cursor to the upper left corner of the spreadsheet.

2. Execute Data/Parse/Format-Line/Create/Format-Line/Edit. The first row in your spreadsheet will be filled with "L", ">" or "*". An "L" should appear above the first letter or number in the data element. For example, if the title "NSN" starts above the second number of the NSN, then an "L"

should appear over the first number of the NSN rather than over the first N in "NSN". A ">" should appear over every number and/or letter in the data element and a "*" should appear over any spaces. Check each space in the first three rows to ensure the symbols are properly aligned as indicated above and then hit the return key. The cursor should again appear in the upper left corner of the worksheet.

3. Execute Input-Column, enter the range A:A1..A:A100, and then hit the return key.

4. Execute Output-Range "Z1", or any other blank column to the right of the spreadsheet. Then hit the return key and Go.

5. Move the cursor to "Z1" and check for extraneous data. For instance, if only the letter "A" appears in each row of column "Z", then delete column "Z". Block "Z1" should have the title of the first data element and the data should appear below it in the column.

6. Move the cursor to block "Z1" and execute File/Extract/Formulas C:\LOTUS\MODULE1.WK3.

7. Repeat this procedure for each of the numbered files mentioned above.

Once you have "parsed" each of the individual files, you are ready to begin incorporating the numbered files into C:\LOTUS\MODULE1.WK3:

1. Clear all of the worksheets by executing the commands Worksheet/Erase/Yes.

2. Retrieve C:\LOTUS\MODULE1.WK3 and move the cursor down to block A101.

3. Execute File/Combine/Copy/Entire-File and enter C:\LOTUS\MOD002.WK3.

4. Move the cursor down to block A201 and repeat step 3 for C:\LOTUS\MOD003.WK3.

5. Continue this process until all of the serial number files have been consolidated in the C:\LOTUS\MODULE1.WK3 spreadsheet.

You are now ready to begin setting up the spreadsheets as described in Appendix D.

2. Database

Appendix D identifies the appropriate columns for the mandatory data elements:

1. Move the data elements to the correct columns and then set column width as specified immediately after the label, {W6}.

2. The formulas and file links should be typed into the second row of blocks as displayed in Appendix D.

3. MACROs can be entered anywhere to the right of the spreadsheet. If the OPTION title is entered in block BA2 and the commands are entered in blocks BC2 and BC3, as indicated in Figure V-2, then move the cursor to block BC2 and execute Range/Name/Create and enter the OPTION name. Numbering or alphabetizing the OPTIONS, as identified in Appendix D, generally works best.

4.Formulas can now be copied from row 2 down to the last row of data in the spreadsheet.

5.Execute File/Save.

	BA	BB	BC
1			
2	OPTIONA	{RECALC D2..D1000}~	
3		{RECALC E2..E1000}~	

Figure V-2 C:\LOTUS\MODULE1.WK3 MACRO

Once you have created and saved your worksheet, there are two features which will be useful in using C:\LOTUS\MODULE1.WK3 to process your line items:

1. Sorting your database: In order to use B:\MODULE3.WK3, Computing Your Load Quantity, you will have to have the database sorted by NSN, Location1 or another data element of your choosing.

   a. Execute Data/Sort/Data-Range and enter the entire database range. For instance, A2..AE1000, unless your data base extends further out than column AE. Hit the return key.

   b. Execute Primary-key to enter the column you want your database sorted from. For a location sort, enter N2...N1000. Identify either Ascending or Descending sort and hit the return key.

   c. Execute Go to begin sorting.

Note: If the user wishes to sort the data base using other than NSN or Location1, additional guidance is provided in subsection 7, Allocating Constrained Space.

2. To execute the MACRO OPTIONS, enter "ALT F3". Highlight the OPTION and hit the return key. The C:\LOTUS\MODULE1.WK3 OPTIONA was designed to expedite data retrieval from A:\MODULE2.WK3, B:\MODULE3.WK3 and B:\MODULE4.WK3.

Execute File/Save, then create a second spreadsheet and name it C:\LOTUS\DEMAND.WK3.

3. Demand

To create the C:\LOTUS\DEMAND.WK3 spreadsheet:

1. Enter the appropriate column labels and widths as identified in Appendix D. There is only one formula and one MACRO entered in this spreadsheet.

2. Copy the equation down to block A1000 in groups of 100. Once the formula is entered in block A2..A1000, the data will be copied from C:\LOTUS\MODULE1.WK3 to the C:\LOTUS\DEMAND.WK3 spreadsheet.

3. Demand data can be entered if the C:\LOTUS\MODULE1.WK3 spreadsheet has been sorted. It is important to remember that the linking formula and MACRO command, {RECALC}, retrieves the NSNs from C:\LOTUS\MODULE1.WK3 based on the sort selection, but the demand history data is not linked to C:\LOTUS\MODULE1.WK3.

4. Execute File/Save.

Once the C:\LOTUS\DEMAND.WK3 spreadsheet has been created, there are two steps to remember for subsequent retrieval and use of the C:\LOTUS\DEMAND.WK3 file:

1. The most current data must be entered in the columns identified as DJAN1 through DDEC1. If there is 24 months of demand data available, the oldest data should be entered in the columns identified as DJAN2 through DDEC2. DJAN2 through DDEC2 are not mandatory entries.

2. The system is currently programmed to accept blocks of 12 or 24 month demand frequency. The formulas in both of the forecast spreadsheets would require a minor modification to accept and accurately forecast data for less than 12 month increments. C:\LOTUS\FORCST.WK3 blocks M2 and Y2 identify the IF/THEN format required in columns M through X and Y through AJ. The same format could also be entered in C:\LOTUS\FORCST2.WK3 columns L through W and X through AI.

Execute File/Save, then create the third spreadsheet and name it C:\LOTUS\FORCST2.WK3.

4. Forecast: Historical Data

To create the C:\LOTUS\FORCST2.WK3 spreadsheet:

1. Enter the appropriate column labels, widths, formulas and the MACRO as identified in Appendix D.

2. Once the formulas have been entered in the appropriate blocks, copy the formulas down to row 1000 in groups of 100.

3. Enter the exponential smoothing constants required in blocks AK2 and AL2. Exponential smoothing constants were discussed in Chapter 3; however the recommended range is between 0.1 and 0.5.

4. Execute OPTIONA if the monthly demand frequency has been entered in the C:\LOTUS\DEMAND.WK3 spreadsheet.

Execute File/Save, then create the fourth spreadsheet and name it C:\LOTUS\FORCST.WK3.

5. **Forecast: Most Recent Data**

To create the C:\LOTUS\FORCST.WK3 spreadsheet:

1. Enter the appropriate column labels, widths, formulas and the MACRO as identified in Appendix D.

2. Once the formulas have been entered in appropriate blocks, copy the formulas down to row 1000 in groups of 100.

3. Enter the exponential smoothing constants required in blocks AL2 and AM2. The recommended range is again between 0.1 and 0.5.

4. Execute OPTIONA if:

   a. the C:\LOTUS\FORCST2.WK3 OPTIONA has been executed for 24 months of demand history data, or

   b. 12 months of demand history data has been entered in the C:\LOTUS\DEMAND.WK3 spreadsheet.

Execute File/Save and you are now ready to create the A:\MODULE2.WK3 spreadsheets.

6. Computing Your Load Quantity

A:\MODULE2.WK3 should be created and saved on separate diskettes since there are 12 versions identified in Appendix D. The user may want to use only one of these versions or a combination of several may be used simultaneously.

Each of the 12 versions identified in Appendix D represent the frequency of resupply as follows:

- 2 weeks
- 3 weeks
- 1 month
- 1½ months
- 2 months
- 3 months
- 4 months
- 5 months
- 6 months
- 7 months
- 8 months
- 9 months

To create the A:\MODULE2.WK3 spreadsheets:

1. Enter the column labels, widths, formulas and MACROS as identified in Appendix D.

2. Once the formulas have been entered in the appropriate blocks, copy the formulas down to row 1000 in groups of 100.

There are 12 MACRO OPTIONS identified in each version of A:\MODULE2.WK3. The appropriate OPTION should not be executed until after OPTIONA has been executed in the C:\LOTUS\FORCST.WK3 spreadsheet. The OPTIONS allow the user to begin load quantity, LDQTY computations beginning in any month of the year as follows:

- OPTION1 - January
- OPTION2 - February
- OPTION3 - March
- OPTION4 - April
- OPTION5 - May
- OPTION6 - June
- OPTION7 - July
- OPTION8 - August
- OPTION9 - September
- OPTION10 - October
- OPTION11 - November
- OPTION12 - December

For instance, if the ship deployed every year from March to June, and resupply was not expected until mid-May, the user would want to compute load quantity computations using Module 2: 2 Months and execute OPTION3.

Execute File/Save, then create the next spreadsheet and name it B:\MODULE3.WK3.

7. Allocating Constrained Space

To create the B:\MODULE3.WK3 spreadsheet:

1. Appendix D identifies the appropriate column labels, widths and formulas. A few of the columns are not required, depending on your USID as identified above. Before entering the appropriate formula for your USID, the formula should be checked against the available data elements entered in C:\LOTUS\MODULE1.WK3. Appendix B provides additional guidance for judging the accuracy of the computations. If necessary, a BMF query may determine whether or not the appropriate data elements were extracted.

2. Once the formulas have been entered in the appropriate blocks, copy the formulas down to row 1000 in groups of 100.

The MACRO OPTIONS and the formula entered in block K2 are also dependent upon the USID:

USIDA	Column G	OPTIONA and OPTIONB or OPTIONF	+D2-G2
USIDB	Column H	OPTIONA and OPTIONC or OPTIONG	+D2-H2
USIDC	Column I	OPTIONA and OPTIOND or OPTIONH	+D2-I2
USIDT	Column J	OPTIONA and OPTIONE or OPTIONI	+D2-J2

Note: OPTIONS B-E are for cubic feet computations and OPTIONS F-I are for one-for-one locations.

The MACRO OPTIONS should be executed after the appropriate MACRO OPTION has been executed in A:\MODULE2.WK3. At this point in the process, there are five important considerations which should be discussed in greater detail.

1. Once the appropriate USID formula has been verified and entered in the B:\MODULE3.WK3 spreadsheet, the user should be able to identify columns which are available for BMF data entry. The recommended data elements discussed above should

be moved to the available columns as identified in Appendix D and to any of the columns no longer required. For instance, USID B could reassign the columns as follows:

SLC	Column A
TSC	Column C
PMIC	Column V
IRC	Column W

2. If the user decides to sort based on a data element other than NSN or Location1, modifications must be made to the B:\MODULE3.WK3 spreadsheet. For instance, to modify B:MODULE3.WK3 for description or nomenclature:

a. move the cursor to block F2 and enter the following formula: +<<C:\LOTUS\MODULE1.WK3>>T1 (or A:T1..A:T1)

b. copy block F2 to block AD2

c. edit block U5 to read as follows:

{MENU}C{CE}AB2~{CE}C2..C1000~{MENU}C{CE}AD2~{CE}F2..F1000~

d. move the cursor to block U4 and execute Range/ Name/Create and enter OPTIONA again in block U4

3. When space is constrained, the user may wish to place greater value on "never out" items. A minor modification is required in Column K. Less weight may be placed on substitute items by multiplying the LALDQ by a value of 0.1 to 0.9 and greater value may be placed on primary items by multiplying the LALDQ by a value greater than one. The equations would be written:

+(+D2-G2)*.5 or +(+D2-G2)*1.5

If the user modifies the equations, the modifications should be added as an "EDIT" after the equations have been copied to the appropriate blocks.

5. Column L, CUFT, is based on information provided by B:\MODULE4.WK3. B:\MODULE4.WK3 must be created and completed prior to executing the MACROS in B:\MODULE3.WK3.

6. Block P2, STG, is based on information computed in the B:\MODULE6.WK3 spreadsheet. B:\MODULE6.WK3 must be created, completed and data entered manually to block P2, prior to execution of the MACROS in B:\MODULE3.WK3. The formulas in

blocks N2 and N4, AVSTG, must also be modified to reflect the correct USID (G, H, I or J). Block N2 is used for cubic feet computations and block N4 is used in one-for-one computations.

Execute File/Save, then create the next spreadsheet and name it B:\MODULE4.WK3.

8. Computing Material Configuration

To create the B:\MODULE4.WK3 spreadsheet:

1. Enter the appropriate column labels, widths, formulas and the MACRO as identified in Appendix D.

2. Once the formulas have been entered in appropriate blocks, copy the formulas down to row 1000 in groups of 100.

3. Enter known CUFT (from the "CARGO" manual) in Column G or compute material CUFT by entering the dimensions in Columns C through E.

MACRO OPTIONA should be executed after the appropriate MACRO OPTIONS have been executed in B:\MODULE3.WK3. Execute File/Save, then create the next spreadsheet and name it B:\MODULE5.WK3 or B:\MODULE6.WK3.

9. Review of Storage Practices

B:\MODULE5.WK3 is an optional spreadsheet which was primarily designed for convenience. To create the B:\MODULE5.WK3 spreadsheet:

1. Enter the appropriate column labels, widths and MACROs as identified in Appendix D.

2. Appendix C, which was extracted from NAVSUP P-485, identifies information that should be reviewed prior to the development of a loadplan. Additional guidance can be incorporated from such references as:

a. Naval Ships' Technical Manual (Chapters 670 and 9230)

b. Hazardous Material Information System (HMIS)

c. OPNAVINST 5100.19 (series) "Navy Safety Precautions for Forces Afloat"

While word processing is not normally performed in a spreadsheet, this particular spreadsheet was designed so that the user would not have to go hunting for the references.

Execute File/Save, then create the final spreadsheet and name it B:\MODULE6.WK3.

10. Computing Your Ship's Configuration

To create the B:\MODULE6.WK3 spreadsheet:

1. Enter the appropriate column labels, widths and formulas.

2. Once the formulas have been entered in appropriate blocks, copy the formulas down to row 1000 in groups of 100.

The formulas consider the storeroom utilization and packing factors discussed in Chapter IV. Stowage can be computed for an entire storeroom, without storage aids, or for a single location.

1. If the user is computing the net stowage capacity for a single storeroom, the storeroom location should be entered in Column B and the storeroom configurations entered in Columns F through I.

2. If the user is computing the net stowage capacity for a single location, the location number should be entered in Column B and the location configurations entered in Columns J through M.

3. If the location is item specific and will accommodate a limited number of items, the total number of one-for-one locations can also be recorded in the spreadsheet. The user should enter the location or locker number in Column B and the number of item specific locations in Column E.

4. To print the spreadsheet so that the information is available for input to B:\MODULE3.WK3, execute Print/Range, enter the appropriate range and enter Go.

Execute File/Save and you are now ready to begin system processing.

11. System Processing

Once the user has created each of the spreadsheets, the following steps are standard:

1. Retrieve the C:\LOTUS\MODULE1.WK3 spreadsheet and sort the database. Execute File/Save.

2. Retrieve the C:\LOTUS\DEMAND.WK3 spreadsheet and execute OPTIONA. Enter demand frequency data. Execute File/Save.

3. Retrieve the C:\LOTUS\FORCST2.WK3 spreadsheet and execute OPTIONA. Execute File/Save.

4. Retrieve the C:\LOTUS\FORCST.WK3 spreadsheet and execute OPTIONA. Execute File/Save.

5. Retrieve the appropriate version of the A:\MODULE2.WK3 spreadsheet and execute the applicable OPTION, 1 through 12. Execute File/Save.

6. Retrieve the B:\MODULE3.WK3 spreadsheet:

   a. Identify the range of line items you wish to work and erase all of the equations in the ranges outside of your designated group. (Do not erase blocks N1..N4.)

b. Execute OPTIONA.

c. Enter the total STG for the storeroom, locations or one-for-one locations under consideration.

d. Execute the appropriate OPTION, B through I, for your USID.

e. Execute File/Save.

f. Retrieve the C:\LOTUS\MODULE1.WK3 spreadsheet and execute OPTIONA.

g. Execute File/Save and then retrieve the B:\MODULE3.WK3 spreadsheet.

7. Repeat step number 6 until all of the line items listed in the C:\LOTUS\MODULE1.WK3 spreadsheet have been updated. Once the C:\LOTUS\MODULE1.WK3 spreadsheet has been completely processed, copy C:\LOTUS\MODULE1.WK3 and C:\LOTUS\MODULE4.WK3 to a separate diskette and set it aside.

8. Erase the C:\LOTUS\MODULE1.WK3 spreadsheet and you are now ready to begin processing your next ASCII file. Import and proceed with "parsing" as indicated in subsection 1 above. Once you have recreated your C:\LOTUS\MODULE1.WK3 spreadsheet, you can repeat steps 1 through 8 until all of the line items have been retrieved from SUADPS and processed through the system.

9. The final step is processing the line items through the CODES program. As discussed in Chapters V and VI, the interface with the CODES program is an area recommended for further research.

The expert system can be used to identify the ship's storage capacity, forecast demand for a specific group of line items and determine the appropriate load quantities. Fast moving items would be allocated a greater percentage of available storage space. For example, the young Lieutenant, discussed in Chapter I, may have a problem safely storing 5-

gallon paint cans for his next deployment. He has 14 line items, but only four of them are fast movers. If he can safely stow 458 5-gallon paint cans and the projected total demand until his next available resupply is 523, the expert system can calculate how the 458 stow-for-sea locations should be allocated. Fast movers, such as, haze grey and deck grey would be allotted a greater number of the available locations and substitute primers or paints could be carried in limited quantities. Once the CODES interface is completed, CODES will assign location numbers based on material and location classifications. If one of the 5-gallon cans was not flammable material, CODES would recommend another storage location, thereby increasing the number of available locations.

C. LIMITATIONS

A major limiting factor for this thesis effort was the size of the computer RAM available while utilizing the LOTUS 123 spreadsheets. This problem arises from a portion of the available RAM being dedicated to the DOS operating system. In order to operate at the maximum efficiency, it is recommended that the computer used for this system have at least two megabytes of RAM available.

In addition, the LOTUS software, Release 3.1, used here is limited in the amount of information it will accept before

recording a "memory full" error. Depending on the amount of information recorded in the C:\LOTUS\MODULE1.WK3 spreadsheet, which is one of the largest spreadsheets, the user may be limited to less than 1000 line items that may be manipulated at any given time.

Another consideration is computer response time. The LOTUS 123 commands employed require a significant number of mathematical and logic computations. In addition, different spreadsheets must be linked in order to complete processing. These two factors can lead to unacceptable processing times. For instance, copying 50 simple linking equations will take three to four minutes to process, whereas 50 complex linking equations can take up to 20 minutes to process. A math co-processor may alleviate these problems and expedite processing times.

Finally, if only one disk drive is available, then it is recommended that the user load all of the spreadsheets except MODULE2.WK3 on the hardrive. If the user wants to use different versions of the MODULE2.WK3 spreadsheet, only one should be used at a time. MODULE2.WK3, MODULE3.WK3 and MODULE4.WK3 must be completed and saved before removing the MODULE2.WK3 diskette from the disk drive, erasing the spreadsheet from memory and utilizing the next version.

While the hardware and software problems described above currently place some restraints on the system and the number

of line items that can be manipulated at any given time, additional diskettes can be used to store data on specific groups of material once they are processed through the system. While this is not the ideal situation, it is a viable one if the computer system being used has the limitations described here.

VI. CONCLUSIONS AND AREAS FOR FURTHER RESEARCH

The young Lieutenant discussed in Chapter I needed a computer to help figure out what quantities of specific materials to load for a deployment and where the materials should be located. Reviewing the replenishment package was also identified as being an insurmountable task, depending on the size of the reorder and the amount of time allotted for review. A computer system can also provide invaluable information for reviewing the replenishment package rather than resorting to experience alone in making a decision on when to reorder specific materials and how much.

While technological innovations in stowing and retrieval systems are improving performance at major shore installations, there does not appear to be any hope of incorporating these enhancements afloat within the foreseeable future. Technical advances at this point in time are limited to compatible software packages which can help to organize workload, isolate information for analysis and provide the tools necessary for effective management. Expert systems could be designed to make decisions on a variety of functions, such as:

- Shelf-Life Management

- Hazardous Material Management
- Division Officer's DCPO/Maintenance Man Workload Planner
- Quality Assurance

The system described here in this thesis was designed to help the Supply Officer, the Stores Officer or the Cargo Officer effectively load his storerooms for a deployment. A working knowledge of material configuration and net stowage capacity is essential when considering a "floor plan" of the magnitude required on United States naval vessels. A computer system which matches material configurations to storage constraints can make the task more manageable.

It is also possible the information provided from the expert system can be useful in refining the procedures for determining the number and size of storerooms, as well as the storage aid requirements on new construction ships. The current process, which is based on COSAL allowance requirements, is a good starting point for determining supply space requirements but it does not consider material carried in stock based on the frequency of demand.

In Chapter V significant hardware and software limitations were identified and represent the major area for further research. If the hardware and software problems could be resolved, this expert system could accommodate the manipulation of several thousands of line items at any given

time. The limitations currently restrict the user to manipulating line items for a specific number of locations. A single storeroom containing 18,000 line items would have to be processed by individual storage aid. If there were 50 Vidmar cabinets in the storeroom, then each Vidmar cabinet would be processed as a single entity. While this may be a time consuming process, it is still a viable solution.

As mentioned in Chapter V, another area for further research is the development of the system interface with MTMC's CODES program. All of the data stored in Module 1: Database, is not required by the CODES program. Only the information pertinent to CODES would need to be recorded on a separate diskette and downloaded to the CODES program. In addition, Module 6: Computing Your Ship's Configuration, would also require some minor modification or download to a diskette configured for CODES interface.

A third area for further research is the retrieval of demand history data from SUADPS. The demand forecasting presented in this system is based on monthly demand. As discussed in Chapter V, an additional File Analyzer and Report Generator (FIANA) would have to be written to retrieve this data.

A fourth area for further research is the interface with the SNAP II system. A final area for further research is the expansion of Module 4: Computing Material Configuration. In

addition to computing material configuration, the Module should provide a series of rules which allow the user to compute the best storage aid for the item in question. For instance, if the item is 0.0021 CUFT and the total quantity to be carried is 400, then the best stowage available may be "A Drawer Unit" since the total CUFT is 0.84. Restrictions could then be placed on the storage aid capacity as follows:

- 0.0000 to 0.0200 = Model S-135 MR20
- 0.0201 to 0.0300 = Model S-135 MR40

(These computations are used for illustrative purposes only and are not indicative of actual storage aid assignments.) Modules 1 and 4 have a block, SA, for recording the best storage aid based on material configuration. This would provide the CODES system, which already considers material classifications, such as hazardous material, with an additional feature for determining the optimal material location.

The benefits provided by an expert system designed to assist the Supply Officer, the Cargo Officer or the Stores Officer in the preparation of an effective loadplan, are improved efficiency and effectiveness, as well as enhanced location and inventory accuracy. The expert system designed in this thesis represents only a small step into an area rich

with possibilities for improving and reducing the Supply Officer's workload afloat.

APPENDIX A

In Chapter III, a variety of COSAL models used by the Navy Supply System were listed and the specific objective of each model was identified. The key objectives and basic principles followed in the development of each of these models are identified in Table A-1 [Ref. 1:p. 4-1 - 4-56]. Since the Ships Parts Control Center uses the Modified Fleet Logistics Support Improvement Program (MOD-FLSIP) Allowance Model most often to choose the range and depth of material in a Coordinated Shipboard Allowance List (COSAL), this model will be reviewed in greater detail. Table A-2 [Ref. 1:p. 2-1 - 2-21, 2-B-1 - 2-B-2, 4-1 - 4-56] [Ref. 9:p. 53-69] [Ref. 13:p. 3-52] provides a detailed explanation of a number of factors critical to understanding how the MOD-FLSIP model works.

The MOD-FLSIP revised allowance policy categorizes material as Demand based and Non-Demand based or Insurance items. The Allowance Quantity for Demand based items can be computed as follows:

In Table A-3 [Ref. 17:p. ID3-36], the forecasted quarterly demand of μ equals (BRF x POP)/4. If μ is greater than or equal to 1.0, then the item is Demand based. The Allowance Quantity is easily identified using the chart in

KEY OBJECTIVES AND BASIC PRINCIPLES

Key Objectives	Basic Principles
- to provide a 90 day level of support for planned and corrective maintenance actions	- items which are components of, or provide support for, repairable equipment which is actually installed on the ship
- 65% Gross Effectiveness, which is the number of requistions filled divided by the total number of requisitions	- items which the ship's personnel are capable of replacing at sea
- 85% Net Effectiveness, which is the number of requisitions filled divided by the total number of requisitions for stocked items	- storage space constraints prevents carrying 1 each of every item meeting the criteria, so the decision to carry an item or not is based on forecasted quarterly demand and on the IMEC code of the item
- to provide a 90% fixed protection for demand based items	- for an item with high of level demand, a quantity is carried to satisfy quarterly demand with a 10% chance of stockout - the ship's Supply Officer's opinions are considered, particularly in regard to the range of items carried

TABLE A-1

APL - Allowance Parts List
APL's are prepared for each piece of equipment and system onboard a ship. The maintenance-significant spares or repair parts necessary to operate and maintain the equipment or system is listed in the APL. Allowance quantities are established only for items with a sufficiently high predicted failure rate.

AQ - Allowance Quantity
The total number of a particular item carried in the Allowance List: COSAL or AVCAL.

BRF - Best Replacement Factor
The annual replacement rate per unit of installed population. Replacement is computed based on usage data from the Navy Maintenance and Material Management (3M) system, Transaction Item Reporting System demand data, or technical judgement used separately or in combination. If an item is less than two years old, then BRF equals the Technical Replacement Factor (TRF).

$$BRF = TRF$$

If an item is over two years old, then BRF is determined by exponentially smoothing the Experienced Demand Replacement Factor (EDRF) plus the old BRF. The exponential smoothing constant used by the Navy Supply System since 1986 is 0.4.

$$BRF = \alpha(EDRF) + (1 - \alpha)(OLD\ BRF)$$
where: $\alpha = 0.4$

CASREP - Casualty Report
A report generated when a critical piece of equipment or major system becomes totally or partially inoperational. Casualties are classified by their degree of seriousness as follows:

C4 - Impact on Secondary Mission capability

TABLE A-2

C3 - Impact on Primary Mission Capability
C2 - Unable to get underway

EDRF - Experienced Demand Replacement Factor
The average system maintenance demand per item. The EDRF reflects the total replenishment demand since the last update divided by the average population since the last update.

$$EDRF = \frac{\text{Demand since last update}}{\text{Avg POP since last update}}$$

EWMA - Exponentially Weighted Moving Average
A method of exponential smoothing normally used for forecasting demand where weight given to past data geometrically decreases over time. For instance:

July forecast = α(June demand) + (1 - α)(June forecast)
where: α is the exponential smoothing constant between 0 and 1

IMEC - Item Mission Essentiality Code
Constructed from the Mission Criticality Code (MCC) and the Material Essentiality Code (MEC).

IMEC	Definition
1	Minor mission impact
2	Loss of secondary mission capability
3	Severe degradation of a primary mission capability
4	Loss of a primary mission capability
5	Not mission capable

The IMEC is determined as follows:

MEC	MCC	IMEC
1 or 5	4	4
1 or 5	3	3
1 or 5	2	2
1 or 5	1	1
3	1 or 4	1

MCC - Mission Criticality Code
The MCC can be assigned to a part based on either of the following criteria:

Based on Maintenance History

Code	
4	The ratio of C3 and C4 CASREPs to C2 CASREPs is at least one to five, and the ratio of C4 to C3 CASREPs is at least one to three.
3	The ratio of C3 and C4 CASREPs to C2 CASREPs is at least one to five, but the ratio of C4 to C3 CASREPs is less than one to three.
2	The ratio of C3 and C4 CASREPs to C2 CASREPs is less than one to five.
1	No CASREP history.

Alternatives for Mission Accomplishment Fail			Impact if All Alternatives
Redundant systems/ equipments/ components available.	Alternatives (excluding redundancies) available.	Neither redundancies nor other alternatives available.	
3	4	4	Total loss of mobility, propulsion or life support.
2	3	4	Severe degradation of mobility or total loss of a primary mission.
1	2	3	Severe degradation of a primary mission.
1	1	2	Total loss or severe degradation of

MEC - **Military Essentiality Code**
Identifies the importance of a particular part to its end item as follows:

Code	Definition
1	failure of the item would render the end item inoperable
3	all other items not 1 or 5
5	failure of the item effects personnel safety

MLSF - **Mobile Logistics Support Force**
Includes: oilers, submarine and destroyer tenders, repair ships and fleet issue ships. (Also called Combat Logistics Force (CLF).)

MRU - **Minimum Replacement Unit**
Non-Demand based items, with an IMEC of 3 or 4, are stocked in sufficient quantities to support one maintenance action.

NSN - **National Stock Number**
Each item is assigned a unique identification number by the Defense Logistics Services Center.

POP - **Population**
The total number of a specific Navy Stock Number required to support all equipment. For instance, if 1 specific gasket is required in each of the 6 pumps installed in engineering spaces, then the total population is 6. If 3 specific gaskets are required in each of the 6 pumps, then the total population is 18.

SM&R - **Source, Maintenance and Recoverability Code**
A five digit code comprised of the following:

- The first two positions indicate whether the items for maintenance, repair and overhaul are to be procured,

manufactured or assembled.

- The third position indicates the lowest maintenance level authorized to remove, replace and use the item.

- The fourth position indicates the lowest maintenance level authorized to totally repair the item although some repairs may be made at a lower level.

- The fifth position indicates the lowest level that can dispose of an item.

- The sixth position can be used for internal management purposes, but is not used by SPCC.

TOR - Technical Override Code
The range or depth of an item can be adjusted by a TOR to reflect requirements that are Non-Demand based. For example:

S - items essential to personnel safety or welfare

P - items required to meet a planned maintenance requirement

TRF - Technical Replacement Factor
When there is less than 2 years of demand data available, the TRF may be determined by either of the following methods:

- a technical expert's estimate of the item's replacement factor

- a similar item's BRF

- the manufacturer's estimate of the item's replacement factor

WSF - Weapon Systems File
SPCC's WSF provides important information critical in determining the allowance quantity, such as: the BRF, the SM&R code, the MRU and essentiality data.

Figure A-1 [Ref. 18:p. D-2], where the forecasted quarterly demand is associated with a corresponding "APL Qty". The "APL Qty" is the Allowance Quantity unless, the quantity needs to be rounded to the MRU or the override quantity is greater. If the forecasted quarterly demand of μ is greater than 100, then the Allowance Quantity can be computed using the formula identified at the bottom of Table A-3. If the forecasted quarterly demand of μ is less than 1.0, then the material is an Insurance item. The Allowance Quantity is determined for Insurance items as identified in Figure A-4. Figure A-4 can be simplified as follows:

- If the item has an IMEC of 1 or 2, and the forecasted quarterly demand is less than 0.25, then the item is either not carried or the quantity is determined by the override code.
- If the item has an IMEC of 1 or 2, and the forecasted quarterly demand is at least 0.25 and less than 1.0, then carry 1 MRU or the quantity determined by the override code. The quantity determined by the override code is carried when it is greater than 1 MRU.
- If the item has an IMEC of 3 or 4, and the forecasted quarterly demand is less than 0.1, then the item is not carried or the quantity is determined by the override code.
- If the item has an IMEC of 3 or 4, and the forecasted quarterly demand is at least 0.1 and less than 0.5, then carry 1 MRU or the quantity determined by the override code. The quantity determined by the override code is carried when it is greater than 1 MRU.
- If the item has an IMEC of 3 or 4, and the forecasted quarterly demand is at least 0.5 and less than 1.0, thencarry 2 MRU or the quantity determined by the override code. The quantity determined by the override code is

carried when it is greater than 2 MRU.[Ref.1:p. 2-1 - 2-21, 2-B-1 - 2-B-2, 4-1 - 4-56] [Ref. 18:p. 2-1 - D-2]

FLSIP APL QUANTITY TABLE

(Based on Annual Replacement Factor X Item Population : BRF x POP)
4

BRF x POP 4	APL Qty
< .025 -	0
.025 -	.49 *
.5 - .999	2
< .0375 -	0
25.5 32	
.0375 -	.999 *
26.4 33	
< .0625 -	0
27.3 34	
.0625 -	.999 *
28.1 35	
1.0 - 1.1	2
1.2 - 1.7	3
1.8 - 2.4	4
2.5 - 3.1	5
3.2 - 3.8	6
3.9 - 4.6	7
4.7 - 5.4	8
5.5 - 6.2	9
6.3 - 7.0	10
7.1 - 7.8	11
7.9 - 8.6	12
8.7 - 9.4	13
9.5 - 9.9	14
10.0 - 10.7	15
10.3 - 11.6	16
11.7 - 12.4	17
12.5 - 13.3	18
13.4 - 14.1	19
14.2 - 15.0	20
15.1 - 15.8	21
15.9 - 16.7	22
16.8 - 17.6	23
17.7 - 18.4	24
18.5 - 19.3	25
19.4 - 20.2	26
20.3 - 21.1	27
21.2 - 21.9	28
22.0 - 22.8	29
22.9 - 23.7	30
23.8 - 24.6	31
24.7 - 25.5	32
25.6 - 26.4	33
26.5 - 27.3	34
27.4 - 28.1	35
28.2 - 29.036	45.0 54
29.1 - 29.937	50.0 60
30.0 - 30.838	55.0 65
30.9 - 31.739	60.0 70
31.8 - 32.640	65.0 76
32.7 - 33.541	70.0 81
33.6 - 34.442	75.0 87
34.5 - 35.343	80.0 92
35.4 - 36.244	85.0 97
36.3 - 37.145	90.0 103
37.2 - 38.046	95.0 108
38.1 - 39.047	100.0 113
39.1 - 39.948	100.0 **
40.0 - 40.849	
40.9 - 41.750	

.1 MODFLSIP

.15 COSAL

.25 COSAL

TABLE A-3

FLSIP APL QUANTITY TABLE (CONT)

*
These items are insurance items and are allowed only if the part to component MEC is vital. If the MEC is vital, the item is allowed in a quantity of one (1) or one minimum replacement unit.

**
If the Mean, (BRF X POP)/4, is greater than 100.0, the allowance quantity can be computed as:

$$\text{Allowance} = \text{Mean} + 1.28\sqrt{\text{Mean}}$$

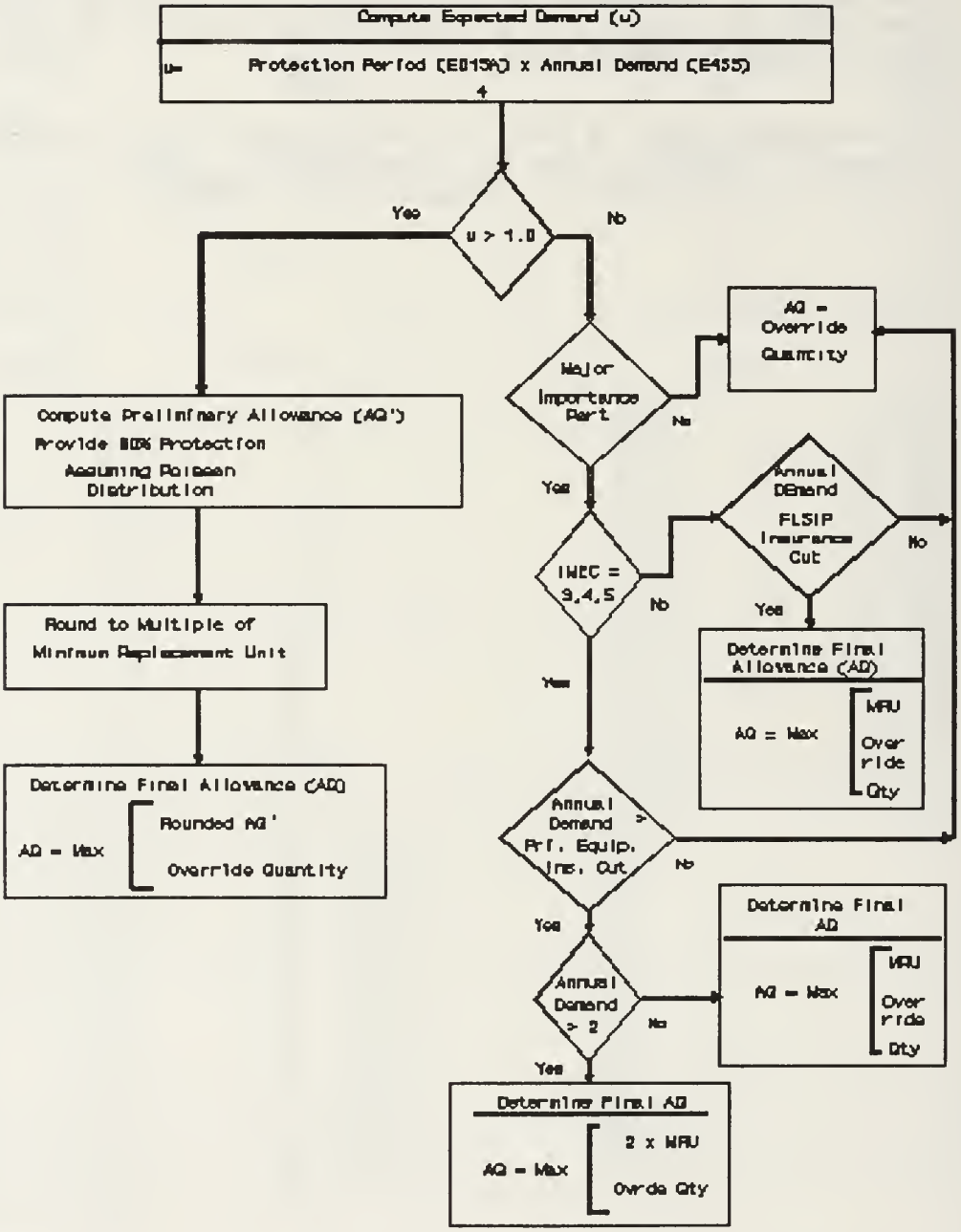


Figure A-1 Mod-FLSIP Allowance

APPENDIX B

The Shipboard Uniform Automated Data Processing System - Real Time is an on-line interactive supply and financial system used on ships with Shipboard Non Tactical ADP Program (SNAP) I computer hardware. The Demand History program computes the average monthly demand and sets the Requisitioning Objective and the Reorder Point based on recorded demand and frequency data. Table B-1 provides a detailed explanation of a number of factors critical to understanding how stock limits are computed.

Reorder Points and Requisitioning Objectives are computed differently for Demand Based Items and Non-Demand Based Items. For Demand Based Items, the Reorder Point (low limit) is computed by adding the Safety Level and the Order and Shipping Time. The Safety Level and the Order and Shipping Time are computed first.

$$SL = 2 \times AMD$$

$$OST = (1, 2 \text{ or } 3 \text{ months}) \times AMD$$

$$RP = SL + OST$$

Constraints on the Safety Level are identified in Table B-2. [Ref. 19:p. 3-1 - 3-6]

The Requisitioning Objective (high limit) is then computed by adding the Reorder Point (low limit) to a factor of the Operating Level Multiplier, the Average Monthly Demand and the Unit Price.

$$RO = RP + OLM\sqrt{\frac{AMD}{UP}}$$

$$OL = OLM\sqrt{\frac{AMD}{UP}}$$

$$OL = RO - RP$$

The Requisitioning Objective (high limit) for Non-Demand Based Items is based on the established allowance or load list quantity as identified in Table B-3. [Ref. 19:p. 3-1 - 3-6]

The Reorder Point (low limit) is then computed as the RO minus one or as a percentage of RO, depending upon the levels set by the Stock Control Officer. [Ref. 19:p. 3-1 - 3-6]

The Stock Control Officer can control stocking objectives for Demand Based Items by entering the parameters for computing the operating level in the Demand History Processing program. The Operating Level Multiplier (OLM), the Maximum months constraint (MAX) and the Minimum months constraint (MIN) are determined by Stock Control. The Operating Level Multiplier (OLM) range is normally between

DEFINITIONS

AVERAGE ENDURANCE LEVEL. The term "average endurance level" is the quantity of material normally required to be on hand to sustain operations for a stated period without augmentation; it is the median between the safety level and stockage objective (i.e., the safety level plus one half the operating level).

AVERAGE MONTHLY DEMAND (AMD). The "AMD" is the computed average number of units requested in a month.

DEMAND. Demand refers to the total number of units requested by the requisitions for a given period of time.

DEMAND BASED ITEM (DBI). The term "demand based item" has the same definition as a POS item.

FREQUENCY OF DEMAND. The term "frequency of demand" or "demand frequency", refers to the number of requests (i.e., "hits") that an item experiences within a given time frame, regardless of the quantities requested or issued.

HIGH LIMIT. The term "high limit" is the maximum quantity of material to be maintained on hand and on order to sustain current operations; it includes the sum of stocks represented by the operating level, the safety level, and order and shipping time. The "high limit" is equivalent to the "requisitioning objective".

LOW LIMIT. The term "low limit" is the stock position which signals the need to initiate replenishment action. It includes the sum of stocks represented by the safety level and the order and shipping time. The "low limit" is equivalent to the "reorder point".

NON-SIM ITEM. A NON-SIM item is an item which does not meet demand frequency for SIM items.

TABLE B-1

NON-DEMAND BASED ITEM (NON-DBI). Inventory items not selected for levels computation based on demand and are set by the AVCAL/COSAL/TARSLL/Tender Load List/FILL/MLOAD.

OPERATING LEVEL (OL). The term "operating level" is the quantity of material (exclusive of safety levels) required to sustain operations during the interval between successive requisitions; normally, it is the difference in the quantity between the requisitioning objective (high limit) and the reorder point (low limit). The OL is computed for demand based items and is designed to reduce the number of repetitive requisitions generated for low-cost, high-usage items and to limit the inventory investment for high-cost items.

OPERATING LEVEL MULTIPLIER (OLM). The "OLM" is a mathematical factor relating to the economic order quantity formula and is used to express the availability of investment dollars and the ability to cope with workload produced by resupply orders. For Demand History Processing, the "OLM" is a range entered in months and tenths of month.

ORDER AND SHIPPING TIME. The term "order and shipping time" is the anticipated (or advertised) time between order and receipt.

ORDER AND SHIPPING TIME (OST) LEVEL. The quantity of material which may be exhausted between the time an item is requisitioned and the date material is received. The OST Level is computed for demand based items.

PEACETIME OPERATING STOCK (POS) ITEM. The term "peacetime operating stock item", which is synonymous with the term "demand based item DBI", is used by automated ships to identify items which have a relatively high issue rate. Normally, an item which experiences a demand frequency of two or more in a period of six months and continues to have at least one demand every six months thereafter is a "POS" item. Criteria for POS items is equivalent to

criteria for SIM items in nonautomated ships. The POS quantity of a POS item is that portion of the requisitioning objective which supplements the allowance and/or load list quantity; if a POS item is not an allowance or load list item, the entire quantity of the requisitioning objective is considered to be POS. Semiannual review of stock records for POS items is required for recomputation of requisitioning objectives.

PRE-POSITIONED WAR RESERVE STOCK (PWRS). The term "PWRS", as defined in the Dictionary of United States Military Terms for Joint Usage, Joint Chiefs of Staff (JCS) Pub. 1, is the quantity of an item acquired and positioned against a pre-positioned war reserve requirement, ie., material which strategic plans dictate be positioned prior to hostilities at or near the point of planned use or issue to the user, to ensure timely support of a specific project or designated force during the initial phase of war, pending arrival of replenishment shipments. In its application afloat, the term "PWRS" technically refers to items and quantities specifically designated as PWRS in the load lists of Combat Logistic Force (CLF) ships; however, in order to provide for a separate basic load requirement for POS items, the term "PWRS", as used by CLF ships, refers to the allowance and load list quantities of each POS item carried.

REORDER POINT. The term "reorder point" is the stock position which signals the need to initiate replenishment action; it includes the sum of stocks represented by the safety level and the order and shipping time. The "reorder point" is equivalent to the "low limit".

REQUISITIONING OBJECTIVE. The term "requisitioning objective" is the maximum quantity of material to be maintained on hand and on order to sustain current operations; it includes the sum of stocks represented

by operating level, safety level, and order and shipping time. The "requisitioning objective" is equivalent to the "high limit".

RETENTION LIMIT. The term "retention limit" refers to the maximum quantity of an item authorized to be retained on board load carrying ships. The retention limit consists of the allowance and/or load list quantity (or the requisitioning objective for demand based items), plus the economic retention quantity as authorized in CINCLANTFLTINST 4440.5 (series) or CINCPACFLTINST 4440.3 (series). Any long supply that exceeds the retention limit is considered as excess.SAFETY LEVEL. The term "safety level" is the quantity of material, in addition to the operating level, required to be on hand to permit continuous operations in the event of interruption of normal replenishment or unpredictable fluctuations in issue demand.

SELECTED ITEM MANAGEMENT (SIM). SIM is an inventory control principle which, in nonautomated ships, focuses management attention on the small percentage of items that experience the majority of on board demands for material.

SIM ITEM. A SIM item is an item which has experienced a frequency of demand of two or more within the past six months or has a predictable demand frequency of two or more based on deployed or seasonal usage. The criteria for a SIM item is similar to criteria for terms "peacetime operating stock" and "demand based item" used in automated ships. Frequency of demand is defined as the number of separate times an item is issued, regardless of the quantity of each issue.

STOCKAGE OBJECTIVE. The term "stockage objective" is the maximum quantity of material to be maintained on hand to sustain current operations; it includes the sum of stocks represented by the operating level and the safety level.

SAFETY LEVEL	
AFS	- SL will not be less than COSAL quantity plus FILL quantity
FBM Tender	- SL will not be less than the largest of the various allowance/load components
Tender	- SL will not be less than the larger of the COSAL components plus TARSLL or not less than MLOAD
CV/LPH/LHA/MAG	- SL is computed by multiplying the SL factor (months) in the parameter by the AMD and comparing the results to any authorized allowance quantity. The SL will be the greater of the two.

TABLE B-2

five and ten months and is an economic order quantity formula used to express the availability of investment dollars and the ability to cope with workload produced by resupply orders. The MAX and MIN determine the size of the Operating Level by imposing constraints on the desired number of months of supply. The suggested MAX range is from six to nine months and the suggested MIN range is from one half to two and a half months. [Ref. 19:p. 3-1 - 3-6]

In addition to setting levels, the Demand History Processing program:

- deletes records when they are no longer required, as specified by the Stock Control Officer,

REQUISITIONING OBJECTIVE	
AFS	- COSAL + FILL.
FBM Tender	- Largest quantity from various allowance/load components.
Tender	- Larger of COSAL components + TARSLL or the MLOAD.
CV/LPH/LHA/MAG	- Largest quantity of COSAL or BCOSAL + AVCAL. If an MLOAD quantity is available, it will be used instead of the previous computation.

TABLE B-3

- excludes specific categories of materials from level setting (QCOSAL and 9X, 8A and 0I Cognizance materials),
- accommodates Type Commander specifications for classifying
- specific items as Demand Based, and changes Allowance Type Codes as necessary (see Table B-4) [Ref. 19:p. 3-1 - 3-6].

ALLOWANCE TYPE CODES
AT Codes 1, 2, 3 and 5 may qualify as DBI.
AT Code 4 items are always DBI.
AT Codes 6, 7, 8 and 9 are never DBI.

TABLE B-4

APPENDIX C

A. GENERAL STOWAGE

This Appendix is a compilation of storage practices to be reviewed prior to using the expert system. [Ref 13:p. 4-1 - 4-95]

General Practices

> Arrange materials with identification labels facing outward to facilitate issues and inventory.

Avoid multiple locations for the same item.

Segregate materials which are dissimilar in type or classification (e.g. hazardous/nonhazardous, large/small, classified/unclassified, SIM/non-SIM, shelf-life/non-shelf-life, etc.).

Main Issue Storeroom

> The main issue storeroom is that storeroom which the supply officer designates as the centralized distribution point for most SIM and shelf-life items, and generally is the most readily accessible of all stock material stowage spaces when watertight integrity restrictions are in effect.

On some ships, particularly large ships, more than one storeroom may be required to be manned and maintained as issue storerooms.

Bulk Storerooms

Bulk storerooms (for general stores) are spaces which are used for stowage of case lots of certain frequently demanded items maintained (in smaller quantities) in an issue storeroom, or for items that are too bulky and cumbersome for stowage in an issue storeroom.

Locate heavy bulk materials in areas most convenient to ship's hatches and materials handling equipment (to minimize the physical effort required for loading, stowage and breakouts).

Locate light, bulky material in storerooms with high overhead clearance (to maximize the use of available space).

Repair Parts Storerooms

Supply department storerooms will be used for the stowage of all repair parts, except bulkhead mounted spares and certain other materials authorized to be stowed in other departmental spaces. Although SIM, shelf-life, and certain other repair parts generally are stored in the main issue storeroom, most repair parts in supply department custody normally will be located in spaces designated as repair parts storerooms, which will be outfitted with bins, drawer cabinets, and other stowage aids considered most appropriate for the types of materials to be stowed. When required, or when available near the operating spaces to be supported, separate storerooms will be used for stowage of electronic repair parts, hull/mechanical/electrical (HMEO&E) and ordnance repair parts, nuclear weapons repair parts, reactor plant repair parts, etc.

B. MISCELLANEOUS MATERIALS

Chronometers

Chronometers are controlled equipage which, in end use ships, is always turned over to the using department(s).

```
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

I. **MODULE2.WK3: 2 Months**

```
A:A1: [W6] '2MOS
A:B1: [W6] 'JF1X2
A:C1: [W6] 'FM1X2
A:D1: [W6] 'MA1X2
A:E1: [W6] 'AM1X2
A:F1: [W6] 'MJ1X2
A:G1: [W6] 'JJ1X2
A:H1: [W6] 'JA1X2
A:I1: [W6] 'AS1X2
A:J1: [W6] 'SO1X2
A:K1: [W6] 'ON1X2
A:L1: [W6] 'ND1X2
A:M1: [W6] 'DJ1X2
A:N1: [W6] 'LDQTY
A:A2: [W6] NO ENTRY REQUIRED
A:B2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:A2..A:A2))
A:C2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:A2..A:A2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:B2..A:B2))
A:D2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:B2..A:B2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:C2..A:C2))
A:E2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:C2..A:C2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:D2..A:D2))
A:F2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:D2..A:D2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:E2..A:E2))
```

```
A:G2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:E2..A:E2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:F2..A:F2))
A:H2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:F2..A:F2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:G2..A:G2))
A:I2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:G2..A:G2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:H2..A:H2))
A:J2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:H2..A:H2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:I2..A:I2))
A:K2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:I2..A:I2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:J2..A:J2))
A:L2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:J2..A:J2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:K2..A:K2))
A:M2: [W6] {F0}
((+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:K2..A:K2))
A:N2: [W6] CREATED BY OPTIONS 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
A:O20: [W6] 'OPTION7
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
```

```
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

J. **MODULE2.WK3: 3 Months**

```
A:A1: [W6] ^3MOS
A:B1: [W6] "JM1X3
A:C1: [W6] "FA1X3
A:D1: [W6] "MM1X3
A:E1: [W6] "AJ1X3
A:F1: [W6] "MJ1X3
A:G1: [W6] "JA1X3
A:H1: [W6] "JS1X3
A:I1: [W6] "AO1X3
A:J1: [W6] "SN1X3
A:K1: [W6] "OD1X3
A:L1: [W6] "NJ1X3
A:M1: [W6] "DF1X3
A:N1: [W6] 'LDQTY
A:A2: NO ENTRY REQUIRED
A:B2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:A2..A:A2)+(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:B2))
A:C2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:A2..A:A2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:B2..A:B2)+(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:C2))
A:D2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:B2..A:B2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:C2..A:C2)+(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:D2))
A:E2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:C2..A:C2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:D2..A:D2)+(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:E2))
A:F2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:D2..A:D2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:E2..A:E2)+(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:F2))
A:G2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:E2..A:E2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:F2..A:F2)+(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:G2))
```

```
A:H2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:F2..A:F2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:G2..A:G2)+(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:H2))
A:I2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:G2..A:G2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:H2..A:H2)+(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:I2))
A:J2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:H2..A:H2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:I2..A:I2)+(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:J2))
A:K2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:I2..A:I2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:J2..A:J2)+(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:K2))
A:L2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:J2..A:J2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:K2..A:K2)+(+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2))
A:M2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:K2..A:K2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:L2..A:L2)+(+<<C:\LOTUS\FORCST.WK3>>A:A2..A:A2))
A:N2: [W6] CREATED BY OPTIONS 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
A:O20: [W6] 'OPTION7
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
```

```
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

K. **MODULE2.WK3: 4 Months**

```
A:A1: [W6] ^4MOS
A:B1: [W6] "JA1X4
A:C1: [W6] "FM1X4
A:D1: [W6] "MJ1X4
A:E1: [W6] "AJ1X4
A:F1: [W6] "MA1X4
A:G1: [W6] "JS1X4
A:H1: [W6] "JO1X4
A:I1: [W6] "AN1X4
A:J1: [W6] "SD1X4
A:K1: [W6] "OJ1X4
A:L1: [W6] "NF1X4
A:M1: [W6] "DM1X4
A:N1: [W6] 'LDQTY
A:A2: [W6] NO ENTRY REQUIRED
A:B2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:A2..A:A2)+(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:B2)+
(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:C2))
A:C2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:A2..A:A2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:B2..A:B2)+(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:C2)+
(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:D2))
A:D2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:B2..A:B2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:C2..A:C2)+(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:D2)+
(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:E2))
A:E2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:C2..A:C2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:D2..A:D2)+(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:E2)+
(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:F2))
A:F2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:D2..A:D2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:E2..A:E2)+(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:F2)+
(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:G2))
A:G2: [W6] (F0)
```

```
((+<<C:\LOTUS\FORCST.WK3>>A:E2..A:E2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:F2..A:F2)+(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:G2)+
(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:H2))
A:H2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:F2..A:F2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:G2..A:G2)+(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:H2)+
(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:I2))
A:I2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:G2..A:G2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:H2..A:H2)+(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:I2)+
(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:J2))
A:J2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:H2..A:H2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:I2..A:I2)+(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:J2)+
(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:K2))
A:K2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:I2..A:I2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:J2..A:J2)+(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:K2)+
(+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2))
A:L2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:J2..A:J2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:K2..A:K2)+(+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+
(+<<C:\LOTUS\FORCST.WK3>>A:A2..A:A2))
A:M2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:K2..A:K2)+(+<<C:\LOTUS\FORCS
T.WK3>>A:L2..A:L2)+(+<<C:\LOTUS\FORCST.WK3>>A:A2..A:A2)+
(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:B2))
A:N2: [W6] CREATED BY OPTIONS 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
A:O20: [W6] 'OPTION7
```

```
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

L. **MODULE2.WK3: 5 Months**

```
A:A1: [W6] ^5MOS
A:B1: [W6] "JM1X5
A:C1: [W6] "FJ1X5
A:D1: [W6] "MJ1X5
A:E1: [W6] "AA1X5
A:F1: [W6] "MS1X5
A:G1: [W6] "JO1X5
A:H1: [W6] "JN1X5
A:I1: [W6] "AD1X5
A:J1: [W6] "SJ1X5
A:K1: [W6] "OF1X5
A:L1: [W6] "NM1X5
A:M1: [W6] "DA1X5
A:N1: [W6] 'LDQTY
A:A2: [W6] NO ENTRY REQUIRED
A:B2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(@SUM(+<<C:\LOTUS\
FORCST.WK3>>A:A2..A:D2)))
A:C2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:F2)
A:D2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:G2)
A:E2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:H2)
A:F2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:I2)
A:G2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:J2)
A:H2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:K2)
A:I2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:L2)
A:J2: [W6] (F0)
```

```
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:L2)+(+<<C:\LOTUS\F
ORCST.WK3>>A:A2..A:A2))
A:K2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:L2)+@SUM(+<<C:\LOT
US\FORCST.WK3>>A:A2..A:B2))
A:L2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:L2)+@SUM(+<<C:\LOT
US\FORCST.WK3>>A:A2..A:C2))
A:M2: [W6] (F0)
(+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+@SUM(+<<C:\LOTUS\FO
RCST.WK3>>A:A2..A:D2)
A:N2: [W6] CREATED BY OPTION 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
A:O20: [W6] 'OPTION7
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
```

```
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

M. **MODULE2.WK3: 6 Months**

```
A:A1: [W6] '6 MOS
A:B1: [W6] "JJ1X6
A:C1: [W6] "FJ1X6
A:D1: [W6] "MA1X6
A:E1: [W6] "AS1X6
A:F1: [W6] "MO1X6
A:G1: [W6] "JN1X6
A:H1: [W6] "JD1X6
A:I1: [W6] "AJ1X6
A:J1: [W6] "SF1X6
A:K1: [W6] "OM1X6
A:L1: [W6] "NA1X6
A:M1: [W6] "DM1X6
A:N1: [W6] 'LDQTY
A:A2: [W6] NO ENTRY REQUIRED
A:B2: [W6] (F0)
((+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(@SUM(+<<C:\LOTUS\
FORCST.WK3>>A:A2..A:E2)))
A:C2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:A2..A:F2)
A:D2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:G2)
A:E2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:H2)
A:F2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:I2)
A:G2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:J2)
A:H2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:K2)
A:I2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:L2)
A:J2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:L2)+(+<<C:\LOTUS\F
ORCST.WK3>>A:A2..A:A2))
A:K2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:L2)+(@SUM(+<<C:\LO
TUS\FORCST.WK3>>A:A2..A:B2)))
A:L2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:L2)+(@SUM(+<<C:\LO
TUS\FORCST.WK3>>A:A2..A:C2)))
A:M2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:L2)+(@SUM(+<<C:\LO
TUS\FORCST.WK3>>A:A2..A:D2)))
A:N2: [W6] CREATED BY OPTIONS 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
```

```
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
A:O20: [W6] 'OPTION7
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

N. MODULE2.WK3: 7 Months

```
A:A1: [W6] '7 MOS
A:B1: [W6] "JJ1X7
A:C1: [W6] "FA1X7
A:D1: [W6] "MS1X7
A:E1: [W6] "AO1X7
A:F1: [W6] "MN1X7
A:G1: [W6] "JD1X7
A:H1: [W6] "JJ1X7
A:I1: [W6] "AF1X7
A:J1: [W6] "SM1X7
A:K1: [W6] "OA1X7
```

```
A:L1: [W6] "NM1X7
A:M1: [W6] "DJ1X7
A:N1: [W6] 'LDQTY
A:A2: [W6] NO ENTRY REQUIRED
A:B2: [W6] (F0)
(+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(@SUM(+<<C:\LOTUS\F
ORCST.WK3>>A:A2..A:F2))
A:C2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:A2..A:G2)
A:D2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:H2)
A:E2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:I2)
A:F2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:J2)
A:G2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:K2)
A:H2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:L2)
A:I2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:L2)+(+<<C:\LOTUS\FO
RCST.WK3>>A:A2..A:A2)
A:J2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:L2)+@SUM(+<<C:\LOTU
S\FORCST.WK3>>A:A2..A:B2)
A:K2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:L2)+@SUM(+<<C:\LOTU
S\FORCST.WK3>>A:A2..A:C2)
A:L2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:L2)+@SUM(+<<C:\LOTU
S\FORCST.WK3>>A:A2..A:D2)
A:M2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:L2)+@SUM(+<<C:\LOTU
S\FORCST.WK3>>A:A2..A:E2)
A:N2: [W6] CREATED BY OPTIONS 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
```

```
A:O20: [W6] 'OPTION7
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

O. **MODULE2.WK3: 8 Months**

```
A:A1: [W6] '8 MOS
A:B1: [W6] "JA1X8
A:C1: [W6] "FS1X8
A:D1: [W6] "MO1X8
A:E1: [W6] "AN1X8
A:F1: [W6] "MD1X8
A:G1: [W6] "JJ1X8
A:H1: [W6] "JF1X8
A:I1: [W6] "AM1X8
A:J1: [W6] "SA1X8
A:K1: [W6] "OM1X8
A:L1: [W6] "NJ1X8
A:M1: [W6] "DJ1X8
A:N1: [W6] 'LDQTY
A:A2: [W6] NO ENTRY REQUIRED
A:B2: [W6] (F0)
(+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(@SUM(+<<C:\LOTUS\F
ORCST.WK3>>A:A2..A:G2))
A:C2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:A2..A:H2)
A:D2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:I2)
A:E2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:J2)
A:F2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:K2)
A:G2: [W6] (F0) @SUM(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:L2)
A:H2: [W6]
(F0)@SUM(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:L2)+(+<<C:\LOTU
S\FORCST.WK3>>A:A2..A:A2)
```

```
A:I2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:L2)+(@SUM(+<<C:\LOT
US\FORCST.WK3>>A:A2..A:B2))
A:J2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:L2)+(@SUM(+<<C:\LOT
US\FORCST.WK3>>A:A2..A:C2))
A:K2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:L2)+(@SUM(+<<C:\LOT
US\FORCST.WK3>>A:A2..A:D2))
A:L2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:L2)+(@SUM(+<<C:\LOT
US\FORCST.WK3>>A:A2..A:E2))
A:M2: [W6] (F0)
@SUM(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:L2)+(@SUM(+<<C:\LOT
US\FORCST.WK3>>A:A2..A:F2))
A:N2: [W6] CREATED BY OPTIONS 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
A:O20: [W6] 'OPTION7
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
```

```
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

P. **MODULE2.WK3: 9 Months**

```
A:A1: [W6] '9 MOS
A:B1: [W6] "JS1X9
A:C1: [W6] "FO1X9
A:D1: [W6] "MN1X9
A:E1: [W6] "AD1X9
A:F1: [W6] "MJ1X9
A:G1: [W6] "JF1X9
A:H1: [W6] "JM1X9
A:I1: [W6] "AA1X9
A:J1: [W6] "SM1X9
A:K1: [W6] "OJ1X9
A:L1: [W6] "NJ1X9
A:M1: [W6] "DA1X9
A:N1: [W6] 'LDQTY
A:A2: [W6] NO ENTRY REQUIRED
A:B2: [W6] (F0)
(+<<C:\LOTUS\FORCST.WK3>>A:L2..A:L2)+(@SUM(+<<C:\LOTUS\F
ORCST.WK3>>A:A2..A:H2))
A:C2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:A2..A:I2))
A:D2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:B2..A:J2))
A:E2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:C2..A:K2))
A:F2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:D2..A:L2))
A:G2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:E2..A:L2))+(+<<C:\LOTUS\
FORCST.WK3>>A:A2..A:A2)
A:H2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:F2..A:L2))+(@SUM(+<<C:\L
OTUS\FORCST.WK3>>A:A2..A:B2))
A:I2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:G2..A:L2))+(@SUM(+<<C:\L
OTUS\FORCST.WK3>>A:A2..A:C2))
A:J2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:H2..A:L2))+(@SUM(+<<C:\L
OTUS\FORCST.WK3>>A:A2..A:D2))
A:K2: [W6] (F0)
```

```
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:I2..A:L2))+(@SUM(+<<C:\L
OTUS\FORCST.WK3>>A:A2..A:E2))
A:L2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:J2..A:L2))+(@SUM(+<<C:\L
OTUS\FORCST.WK3>>A:A2..A:F2))
A:M2: [W6] (F0)
(@SUM(+<<C:\LOTUS\FORCST.WK3>>A:K2..A:L2))+(@SUM(+<<C:\L
OTUS\FORCST.WK3>>A:A2..A:G2))
A:N2: [W6] CREATED BY OPTIONS 1-12

A:O1: [W6] MACRO DIRECTORY
A:O2: [W6] 'OPTION1
A:Q2: [W6] '{RECALC B2..B1000}~
A:Q3: [W6] '{MENU}RV{CE}B2..B1000~{CE}N2..N1000~
A:O5: [W6] 'OPTION2
A:Q5: [W6] '{RECALC C2..C1000}~
A:Q6: [W6] '{MENU}RV{CE}C2..C1000~{CE}N2..N1000~
A:O8: [W6] 'OPTION3
A:Q8: [W6] '{RECALC D2..D1000}~
A:Q9: [W6] '{MENU}RV{CE}D2..D1000~{CE}N2..N1000~
A:O11: [W6] 'OPTION4
A:Q11: [W6] '{RECALC E2..E1000}~
A:Q12: [W6] '{MENU}RV{CE}E2..E1000~{CE}N2..N1000~
A:O14: [W6] 'OPTION5
A:Q14: [W6] '{RECALC F2..F1000}~
A:Q15: [W6] '{MENU}RV{CE}F2..F1000~{CE}N2..N1000~
A:O17: [W6] 'OPTION6
A:Q17: [W6] '{RECALC G2..G1000}~
A:Q18: [W6] '{MENU}RV{CE}G2..G1000~{CE}N2..N1000~
A:O20: [W6] 'OPTION7
A:Q20: [W6] '{RECALC H2..H1000}~
A:Q21: [W6] '{MENU}RV{CE}H2..H1000~{CE}N2..N1000~
A:O23: [W6] 'OPTION8
A:Q23: [W6] '{RECALC I2..I1000}~
A:Q24: [W6] '{MENU}RV{CE}I2..I1000~{CE}N2..N1000~
A:O26: [W6] 'OPTION9
A:Q26: [W6] '{RECALC J2..J1000}~
A:Q27: [W6] '{MENU}RV{CE}J2..J1000~{CE}N2..N1000~
A:O29: [W6] 'OPTION10
A:Q29: [W6] '{RECALC K2..K1000}~
A:Q30: [W6] '{MENU}RV{CE}K2..K1000~{CE}N2..N1000~
A:O32: [W6] 'OPTION11
A:Q32: [W6] '{RECALC L2..L1000}~
A:Q33: [W6] '{MENU}RV{CE}L2..L1000~{CE}N2..N1000~
A:O35: [W6] 'OPTION12
A:Q35: [W6] '{RECALC M2..M1000}~
A:Q36: [W6] '{MENU}RV{CE}M2..M1000~{CE}N2..N1000~
```

Q. **MODULE3.WK3**

```
A:A1: [W1] NOT USED
A:B1: [W14] "NSN
A:C1: [W7] "LOC1
A:D1: [W6] "LDQTY
A:E1: [W6] {F2} "LOAD
A:F1: [W12] "OTHER
A:G1: [W6] 'USIDA
A:H1: [W6] 'USIDB
A:I1: [W6] 'USIDC
A:J1: [W6] 'USIDT
A:K1: [W6] 'LALDQ
A:L1: [W6] 'CUFT
A:M1: [W6] 'LUPDT
A:N1: [W6] 'CAVSTG:  CUBIC FEET
A:N3: [W6] '1F1AVST:  ONE FOR ONE STORAGE LOCATIONS
A:O1: [W7] 'LOADF
A:P1: [W7] {F0} ^STG
A:Q1: [W7] 'CALL/LL
A:A2: [W1] NO ENTRY REQUIRED
A:B2: [W14] {F0} +<<C:\LOTUS\MODULE1.WK3>>A:F2..A:F2
A:C2: [W7] {F0} +<<C:\LOTUS\MODULE1.WK3>>A:N2..A:N2
A:D2: [W6] {F0} +<<A:\MODULE2.WK3>>A:N2..A:N2
A:E2: [W6] {F2}
@IF($N$2>0,+M2-(M2/@SUM($M$2..$M$1000))*(@SUM($M$2..$M$1
000)-$N$2),+K2-(K2/@SUM($K$2..$K$1000))*(@SUM($K$2..$K$1
000)-$N$4))
A:F2: [W12] TO BE USED WHEN THE DATABASE IS SORTED USING
OTHER THAN GROUP AND CLASS OR LOCATION1
A:G2: [W6] {F2}
(+<<C:\LOTUS\MODULE1.WK3>>A:H2..A:H2)+(+<<C:\LOTUS\MODUL
E1.WK3>>A:I2..A:I2)
A:H2: [W6] {F2}
@MAX(+<<C:\LOTUS\MODULE1.WK3>>A:H2..A:H2,+<<C:\LOTUS\MOD
ULE1.WK3>>A:I2..A:I2,+<<C:\LOTUS\MODULE1.WK3>>A:J2..A:J2
,+<<C:\LOTUS\MODULE1.WK3>>A:R2..A:R2,+<<C:\LOTUS\MODULE1
.WK3>>A:U2..A:U2,+<<C:\LOTUS\MODULE1.WK3>>A:X2..A:X2,+<<
C:\LOTUS\MODULE1.WK3>>A:Z2..A:Z2,+<<C:\LOTUS\MODULE1.WK3
>>A:AA2..A:AA2)
A:I2: [W6] {F2}
@MAX((@SUM(+<<C:\LOTUS\DEMAND.WK3>>A:B2..A:M2))/12,(@MAX
(+<<C:\LOTUS\MODULE1.WK3>>A:H2..A:H2,+<<C:\LOTUS\MODULE1
.WK3>>A:R2..A:R2,+<<C:\LOTUS\MODULE1.WK3>>A:V2..A:V2,+<<
C:\LOTUS\MODULE1.WK3>>A:W2..A:W2,+<<C:\LOTUS\MODULE1.WK3
>>A:Y2..A:Y2)))
A:J2: [W6] {F2}
```

```
@MAX((+<<C:\LOTUS\MODULE1.WK3>>A:H2..A:H2)+(+<<C:\LOTUS\
MODULE1.WK3>>A:AA2..A:AA2),+<<C:\LOTUS\MODULE1.WK3>>A:R2
..A:R2)
A:K2: [W6] (F0) +D2-G2 (OR -H2, I2, J2)
A:L2: [W6] (F0) +<<B:\MODULE4.WK3>>A:H2..A:H2
A:M2: [W6] (F0) +K2*L2
A:N2: [W6] +P2-@SUM(Q2..Q1000)
A:N4: [W6] +P2-@SUM(K2..K1000)
A:O2: [W7] (F0) (+E2/L2)+G2
A:P2: [W7] MANUAL ENTRY: AVAILABLE STORAGE SPACE, CAN BE
COMPUTED USING MODULE6
A:Q2: [W7] +G2*L2 (OR +H2, I2 OR J2)

A:S1: [W7] 'MACRO DIRECTORY
A:S4: [W7] 'OPTIONA
A:U4: [W7] '{MENU}C{CE}AA2~{CE}B2..B1000~
A:U5: [W7] '{MENU}C{CE}AB2~{CE}C2..C1000~
A:U6: [W7] '{MENU}C{CE}AC2~{CE}D2..D1000~
A:S8: [W7] 'OPTIONB
A:U8: [W7] '{RECALC G2..G1000}~
A:U9: [W7] '{RECALC K2..K1000}~
A:U10: [W7] '{RECALC L2..L1000}~
A:U11: [W7] '{RECALC M2..M1000}~
A:U12: [W7] '{RECALC Q2..Q1000}~
A:U13: [W7] '{RECALC N2}~
A:U14: [W7] '{RECALC E2..E1000}~
A:U15: [W7] '{RECALC O2..O1000}~
A:S17: [W7] 'OPTIONC
A:U17: [W7] '{RECALC H2..H1000}~
A:U18: [W7] '{RECALC K2..K1000}~
A:U19: [W7] '{RECALC L2..L1000}~
A:U20: [W7] '{RECALC M2..M1000}~
A:U21: [W7] '{RECALC Q2..Q1000}~
A:U22: [W7] '{RECALC N2}~
A:U23: [W7] '{RECALC E2..E1000}~
A:U24: [W7] '{RECALC O2..O1000}~
A:S26: [W7] 'OPTIOND
A:U26: [W7] '{RECALC I2..I1000}~
A:U27: [W7] '{RECALC K2..K1000}~
A:U28: [W7] '{RECALC L2..L1000}~
A:U29: [W7] '{RECALC M2..M1000}~
A:U30: [W7] '{RECALC Q2..Q1000}~
A:U31: [W7] '{RECALC N2}~
A:U32: [W7] '{RECALC E2..E1000}~
A:U33: [W7] '{RECALC O2..O1000}~
A:S35: [W7] 'OPTIONE
A:U35: [W7] '{RECALC J2..J1000}~
A:U36: [W7] '{RECALC K2..K1000}~
A:U37: [W7] '{RECALC L2..L1000}~
```

```
A:U38: [W7] '{RECALC M2..M1000}~
A:U39: [W7] '{RECALC Q2..Q1000}~
A:U40: [W7] '{RECALC N2}~
A:U41: [W7] '{RECALC E2..E1000}~
A:U42: [W7] '{RECALC O2..O1000}~
A:S44: [W7] 'OPTIONF
A:U44: [W7] '{RECALC G2..G1000}~
A:U45: [W7] '{RECALC K2..K1000}~
A:U46: [W7] '{RECALC L2..L1000}~
A:U47: [W7] '{RECALC M2..M1000}~
A:U48: [W7] '{RECALC Q2..Q1000}~
A:U49: [W7] '{RECALC N4}~
A:U50: [W7] '{RECALC E2..E1000}~
A:U51: [W7] '{RECALC O2..O1000}~
A:S53: [W7] 'OPTIONG
A:U53: [W7] '{RECALC H2..H1000}~
A:U54: [W7] '{RECALC K2..K1000}~
A:U55: [W7] '{RECALC L2..L1000}~
A:U56: [W7] '{RECALC M2..M1000}~
A:U57: [W7] '{RECALC Q2..Q1000}~
A:U58: [W7] '{RECALC N4}~
A:U59: [W7] '{RECALC E2..E1000}~
A:U60: [W7] '{RECALC O2..O1000}~
A:S62: [W7] 'OPTIONH
A:U62: [W7] '{RECALC I2..I1000}~
A:U63: [W7] '{RECALC K2..K1000}~
A:U64: [W7] '{RECALC L2..L1000}~
A:U65: [W7] '{RECALC M2..M1000}~
A:U66: [W7] '{RECALC Q2..Q1000}~
A:U67: [W7] '{RECALC N4}~
A:U68: [W7] '{RECALC E2..E1000}~
A:U69: [W7] '{RECALC O2..O1000}~
A:S71: [W7] 'OPTIONI
A:U71: [W7] '{RECALC J2..J1000}~
A:U72: [W7] '{RECALC K2..K1000}~
A:U73: [W7] '{RECALC L2..L1000}~
A:U74: [W7] '{RECALC M2..M1000}~
A:U75: [W7] '{RECALC Q2..Q1000}~
A:U76: [W7] '{RECALC N4}~
A:U77: [W7] '{RECALC E2..E1000}~
A:U78: [W7] '{RECALC O2..O1000}~
```

R. **MODULE4.WK3**

```
A:A1: [W1} NOT USED
A:B1: [W14] "NSN
A:C1: [W7] "LINCH
```

```
A:D1: [W7] "WINCH
A:E1: [W7] "HINCH
A:F1: [W7] "COMPC
A:G1: [W7] "ENTRC
A:H1: [W7] "CUFT
A:I1: [W6] 'LDQTY
A:J1: [W7] "TCUFT
A:K1: [W6] {F0} "LOAD
A:L1: [W6] 'RTCUFT
A:M1: [W6] "SA
A:A2: [W1] NO ENTRY REQUIRED
A:B2: [W14] {F0} +<<B:\MODULE3.WK3>>A:B2..A:B2
A:C2: [W7] MANUAL ENTRY REQUIRED:  MATERIAL LENGTH IN
INCHES
A:D2: [W7] MANUAL ENTRY REQUIRED:  MATERIAL WIDTH IN
INCHES
A:E2: [W7] MANUAL ENTRY REQUIRED:  MATERIAL HEIGHT IN
INCHES
A:F2: [W7] {F0} (+C2*D2*E2)/1728
A:G2: [W7] ENTER KNOWN CUFT
A:H2: [W7] {F2} @IF(F2>0,+F2,+G2)
A:I2: [W6] {F0} +<<B:\MODULE3.WK3>>A:D2..A:D2
A:J2: [W7] {F0} +H2*I2
A:K2: [W6] {F0} +<<B:\MODULE3.WK3>>A:O2..A:O2
A:L2: [W6] {F0} +H2*K2
A:M2: [W6] USED IF MODULE4 IS COMPLETED

 MACRO
A:O2: [W6] 'OPTIONA
A:Q2: [W6] '{MENU}C{CE}U2~{CE}B2..B1000~
A:Q3: [W6] '{MENU}C{CE}V2~{CE}C2..C1000~
A:Q4: [W6] '{MENU}C{CE}W2~{CE}D2..D1000~
A:Q5: [W6] '{MENU}C{CE}X2~{CE}E2..E1000~
A:Q6: [W6] '{MENU}C{CE}Y2~{CE}F2..F1000~
A:Q7: [W6] '{MENU}C{CE}Z2~{CE}G2..G1000~
A:Q8: [W6] '{MENU}C{CE}AA2~{CE}H2..H1000~
A:Q9: [W6] '{MENU}C{CE}AB2~{CE}I2..I1000~
A:Q10: [W6] '{MENU}C{CE}AC2~{CE}J2..J1000~
A:Q11: [W6] '{MENU}C{CE}AD2~{CE}K2..K1000~
A:Q12: [W6] '{MENU}C{CE}AE2~{CE}L2..L1000~
```

S. **MODULE5.WK3**

```
A:A1: [W72] ^Review Of Storage Practices
A:A3: [W72] '  1.  General
ENTER ALT F3 AND CHOOSE OPTION1
A:A5: [W72] '  2.  Hazardous
```

```
ENTER ALT F3 AND CHOOSE OPTION2
A:A7: [W72] '  3.  Controlled Material
ENTER ALT F3 AND CHOOSE OPTION3
A:A9: [W72] '  4.  Shelf-Life
ENTER ALT F3 AND CHOOSE OPTION4
A:A11: [W72] '  5.  Proceed to Macro Directory
ENTER ALT F3 AND CHOOSE OPTION5
A:A21: [W72] ^GENERAL
A:A22: [W72] '  1.   Fast Movers
ENTER ALT F3 AND CHOOSE OPTION6
A:A24: [W72] '  2.   Slow Movers
ENTER ALT F3 AND CHOOSE OPTION7
A:A26: [W72] '  3.   Bulk
ENTER ALT F3 AND CHOOSE OPTION8
A:A28: [W72] '  4.   Binnables
ENTER ALT F3 AND CHOOSE OPTION9
A:A30: [W72] '  5.   Air Conditioned Spaces
ENTER ALT F3 AND CHOOSE OPTION10
A:A32: [W72] '  6.   DLR'S
ENTER ALT F3 AND CHOOSE OPTION11
A:A34: [W72] '  7.   QCOSAL
ENTER ALT F3 AND CHOOSE OPTION12
A:A36: [W72] '  8.   Pilferable
ENTER ALT F3 AND CHOOSE OPTION13
A:A38: [W72] '  9.   Medical
ENTER ALT F3 AND CHOOSE OPTION14
A:A40: [W72] ^TO CONTINUE ENTER ALT F3 AND CHOOSE
OPTION15
A:A42: [W72] '  10.  Clothing/Foul Weather Gear
ENTER ALT F3 AND CHOOSE OPTION16
A:A44: [W72] '  11.  Sheet Metal/Bar Stock
ENTER ALT F3 AND CHOOSE OPTION17
A:A46: [W72] '  12.  Computer Parts/ADPE Equipment
ENTER ALT F3 AND CHOOSE OPTION18
A:A48: [W72] '  13.  Custodial
ENTER ALT F3 AND CHOOSE OPTION19
A:A50: [W72] '  14.  General
ENTER ALT F3 AND CHOOSE OPTION20
A:A52: [W72] '  15.  Unused
ENTER ALT F3 AND CHOOSE OPTION21
A:A54: [W72] '  16.  Unused
ENTER ALT F3 AND CHOOSE OPTION22
A:A56: [W72] '  17.  Unused
ENTER ALT F3 AND CHOOSE OPTION23
A:A58: [W72] '  18.  Unused
ENTER ALT F3 AND CHOOSE OPTION24
A:A60: [W72] '  * Return to main menu.
ENTER HOME
A:A61: [W72] ^HAZARDOUS
```

```
A:A62: [W72] '  1.   Gases
ENTER ALT F3 AND CHOOSE OPTION25
A:A64: [W72] '  2.   Flammables
ENTER ALT F3 AND CHOOSE OPTION26
A:A66: [W72] '  3.   Oxidizers
ENTER ALT F3 AND CHOOSE OPTION27
A:A68: [W72] '  4.   Acids
ENTER ALT F3 AND CHOOSE OPTION28
A:A70: [W72] '  5.   Corrosives
ENTER ALT F3 AND CHOOSE OPTION29
A:A72: [W72] '  6.   Alcohol
ENTER ALT F3 AND CHOOSE OPTION30
A:A74: [W72] '  7.   Calcium Hypochlorite
ENTER ALT F3 AND CHOOSE OPTION31
A:A76: [W72] '  8.   Radioactive
ENTER ALT F3 AND CHOOSE OPTION32
A:A78: [W72] '  9.   Other
ENTER ALT F3 AND CHOOSE OPTION33
A:A80: [W72] ^TO CONTINUE ENTER ALT F3 AND CHOOSE
OPTION34
A:A82: [W72] '  10.  Unused
ENTER ALT F3 AND CHOOSE OPTION35
A:A84: [W72] '  11.  Unused
ENTER ALT F3 AND CHOOSE OPTION36
A:A86: [W72] '  12.  Unused
ENTER ALT F3 AND CHOOSE OPTION37
A:A88: [W72] '  13.  Unused
ENTER ALT F3 AND CHOOSE OPTION38
A:A90: [W72] '  14.  Unused
ENTER ALT F3 AND CHOOSE OPTION39
A:A100: [W72] '  * Return to main menu.
ENTER HOME
A:A101: [W72] ^CONTROLLED MATERIAL
A:A102: [W72] '  1.   SUBSAFE
ENTER ALT F3 AND CHOOSE OPTION40
A:A104: [W72] '  2.   Level 1
ENTER ALT F3 AND CHOOSE OPTION41
A:A106: [W72] '  3.   TARGET
ENTER ALT F3 AND CHOOSE OPTION42
A:A108: [W72] '  4.   Bar Stock
ENTER ALT F3 AND CHOOSE OPTION43
A:A110: [W72] '  5.   Unused
ENTER ALT F3 AND CHOOSE OPTION44
A:A112: [W72] '  6.   Unused
ENTER ALT F3 AND CHOOSE OPTION45
A:A114: [W72] '  7.   Unused
ENTER ALT F3 AND CHOOSE OPTION46
A:A116: [W72] '  8.   Unused
ENTER ALT F3 AND CHOOSE OPTION47
```

```
A:A118: [W72] '  9.   Unused
ENTER ALT F3 AND CHOOSE OPTION48
A:A120: [W72] ^TO CONTINUE ENTER ALT F3 AND CHOOSE
OPTION49
A:A122: [W72] '  10.  Unused
ENTER ALT F3 AND CHOOSE OPTION50
A:A124: [W72] '  11.  Unused
ENTER ALT F3 AND CHOOSE OPTION51
A:A126: [W72] '  12.  Unused
ENTER ALT F3 AND CHOOSE OPTION52
A:A140: [W72] '  * Return to main menu.
ENTER HOME
A:A141: [W72] ^SHELF-LIFE
A:A143: [W72] '  To review Shelf-Life
ENTER ALT F3 AND CHOOSE OPTION53
A:A160: [W72] '  * Return to main menu.
ENTER HOME
A:B1: [W72] ^FAST MOVERS
A:B3: [W72] '  1.  Page Down to the subject:
A:B5: [W72] '      a.  General
A:B7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:C1: [W72] ^SLOW MOVERS
A:C3: [W72] '  1.  Page Down to the subject:
A:C5: [W72] '      a.  General
A:C7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:D1: [W72] ^BULK
A:D3: [W72] '  1.  Page Down to the subject:
A:D5: [W72] '      a.  General
A:D7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:E1: [W72] ^BINNABLES
A:E3: [W72] '  1.  Page Down to the subject:
A:E5: [W72] '      a.  General
A:E7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:F1: [W72] ^AIR CONDITIONED SPACES (film/batteries)
A:F3: [W72] '  1.  Page Down to the subject:
A:F5: [W72] '      a.  General
A:F7: [W72] '      b.  Delicate Instruments
A:F9: [W72] '      c.  Film
A:F11: [W72] '     d.  Batteries
A:F13: [W72] '  2.  Return to main menu screen
ENTER HOME
A:G1: [W72] ^DLR's
A:G3: [W72] '  1.  Page Down to the subject:
A:G5: [W72] '      a.  General
A:G7: [W72] '  2.  Return to main menu screen
```

```
ENTER HOME
A:H1: [W72] ^QCOSAL
A:H3: [W72] '  1.  Page Down to the subject:
A:H5: [W72] '       a.  General
A:H7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:I1: [W72] ^PILFERABLE
A:I3: [W72] '  1.  Page Down to the subject:
A:I5: [W72] '       a.  General
A:I7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:J1: [W72] ^MEDICAL
A:J3: [W72] '  1.  Page Down to the subject:
A:J5: [W72] '       a.  General
A:J7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:K1: [W72] ^CLOTHING/FOUL WEATHER GEAR
A:K3: [W72] '  1.  Page Down to the subject:
A:K5: [W72] '       a.  General
A:K7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:L1: [W72] ^SHEET METAL/BAR STOCK
A:L3: [W72] '  1.  Page Down to the subject:
A:L5: [W72] '       a.  General
A:L7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:M1: [W72] ^COMPUTER PARTS/ADPE EQUIPMENT
A:M3: [W72] '  1.  Page Down to the subject:
A:M5: [W72] '       a.  General
A:M7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:N1: [W72] ^CUSTODIAL
A:N3: [W72] '  1.  Page Down to the subject:
A:N5: [W72] '       a.  General
A:N7: [W72] '       b.  Classified Material
A:N9: [W72] '       c.  Alcohol
A:N11: [W72] '      d.  Personnel Forms and ID Cards
A:N13: [W72] '      e.  Controlled Medical
A:N15: [W72] '      f.  Precious Metals
A:N17: [W72] ' 2.  Return to main menu screen
ENTER HOME
A:O1: [W72] ^GENERAL
A:O3: [W72] '  1.  Page Down to the subject:
A:O5: [W72] '       a.  General
A:O7: [W72] '       b.  Main Issue Storeroom
A:O9: [W72] '       c.  Chronometers
A:O11: [W72] '      d.  Motors and Generators
A:O13: [W72] '      e.  Liquid Dielectric Capacitors
A:O15: [W72] ' 2.  Return to main menu screen
```

```
ENTER HOME
A:P3: [W72] ^(Unused)
A:P5: [W72] '  *Return to main menu screen
ENTER HOME
A:Q3: [W72] ^(Unused)
A:Q5: [W72] '  *Return to main menu screen
ENTER HOME
A:R3: [W72] ^(Unused)
A:R5: [W72] '  *Return to main menu screen
ENTER HOME
A:S3: [W72] ^(Unused)
A:S5: [W72] '  *Return to main menu screen
ENTER HOME
A:T1: [W72] ^GASES
A:T3: [W72] '  1.  Page Down to the subject:
A:T5: [W72] '       a.  General
A:T7: [W72] '       b.  Acetylene
A:T9: [W72] '       c.  Oxygen and Chlorine
A:T11: [W72] '      d.  Nonflammable Gases
A:T13: [W72] '      e.  Aerosol Products
A:T15: [W72] '      f.  Freon
A:T17: [W72] ' 2.  Return to main menu screen
ENTER HOME
A:U1: [W72] ^FLAMMABLES
A:U3: [W72] '  1.  Page Down to the subject:
A:U5: [W72] '       a.  General
A:U7: [W72] '       b.  Storerooms
A:U9: [W72] '       c.  Petroleum Products
A:U11: [W72] ' 2.  Return to main menu screen
ENTER HOME
A:V1: [W72] ^OXIDIZERS
A:V3: [W72] '  1.  Page Down to the subject:
A:V5: [W72] '       a.  General
A:V7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:W1: [W72] ^ACIDS
A:W3: [W72] '  1.  Page Down to the subject:
A:W5: [W72] '       a.  General
A:W7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:X1: [W72] ^CORROSIVES
A:X3: [W72] '  1.  Page Down to the subject:
A:X5: [W72] '       a.  General
A:X7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:Y1: [W72] ^ALCOHOL
A:Y3: [W72] '  1.  Page Down to the subject:
A:Y5: [W72] '       a.  General
A:Y7: [W72] '  2.  Return to main menu screen
```

```
ENTER HOME
A:Z1: [W72] ^CALCIUM HYPOCHLORITE
A:Z3: [W72] '  1.  Page Down to the subject:
A:Z5: [W72] '      a.  General
A:Z7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:AA1: [W72] ^RADIOACTIVE
A:AA3: [W72] '  1.  Page Down to the subject:
A:AA5: [W72] '      a.  General
A:AA7: [W72] '      b.  Electron Tubes
A:AA9: [W72] '      c.  Magnetrons
A:AA11: [W72] ' 2.  Return to main menu screen
ENTER HOME
A:AB1: [W72] ^OTHER
A:AB3: [W72] '  1.  Page Down to the subject:
A:AB5: [W72] '      a.  General
A:AB7: [W72] '      b.  Organic Chlorine Laundry Bleach
A:AB9: [W72] '      c.  Toxic Substances
A:AB11: [W72] ' 2.  Return to main menu screen
ENTER HOME
A:AC3: [W72] ^(Unused)
A:AC5: [W72] '  *Return to main menu screen
ENTER HOME
A:AD3: [W72] ^(Unused)
A:AD5: [W72] '  *Return to main menu screen
ENTER HOME
A:AE3: [W72] ^(Unused)
A:AE5: [W72] '  *Return to main menu screen
ENTER HOME
A:AF3: [W72] ^(Unused)
A:AF5: [W72] '  *Return to main menu screen
ENTER HOME
A:AG3: [W72] ^(Unused)
A:AG5: [W72] '  *Return to main menu screen
ENTER HOME
A:AH1: [W72] ^SUBSAFE
A:AH3: [W72] '  1.  Page Down to the subject:
A:AH5: [W72] '      a.  General
A:AH7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:AI1: [W72] ^LEVEL 1
A:AI3: [W72] '  1.  Page Down to the subject:
A:AI5: [W72] '      a.  General
A:AI7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:AJ1: [W72] ^TARGET
A:AJ3: [W72] '  1.  Page Down to the subject:
A:AJ5: [W72] '      a.  General
A:AJ7: [W72] '  2.  Return to main menu screen
```

```
ENTER HOME
A:AK1: [W72] ^BAR STOCK
A:AK3: [W72] '  1.  Page Down to the subject:
A:AK5: [W72] '      a.  General
A:AK7: [W72] '  2.  Return to main menu screen
ENTER HOME
A:AL3: [W72] ^(Unused)
A:AL5: [W72] '  *Return to main menu screen
ENTER HOME
A:AM3: [W72] ^(Unused)
A:AM5: [W72] '  *Return to main menu screen
ENTER HOME
A:AN3: [W72] ^(Unused)
A:AN5: [W72] '  *Return to main menu screen
ENTER HOME
A:AO3: [W72] ^(Unused)
A:AO5: [W72] '  *Return to main menu screen
ENTER HOME
A:AP3: [W72] ^(Unused)
A:AP5: [W72] '  *Return to main menu screen
ENTER HOME
A:AQ3: [W72] ^(Unused)
A:AQ5: [W72] '  *Return to main menu screen
ENTER HOME
A:AR3: [W72] ^(Unused)
A:AR5: [W72] '  *Return to main menu screen
ENTER HOME
A:AS1: [W72] ^SHELF-LIFE
A:AS3: [W72] '  1.  Page Down to the subject:
A:AS5: [W72] '      a.  General
A:AS7: [W72] '  2.  Return to main menu screen
ENTER HOME

A:AU1: [W21] 'MACRO DIRECTORY
A:AU3: [W21] 'OPTION1 MACRO
A:AV3: [W30] '{HOME}~
A:AV4: [W30] '{D 39}~
A:AV5: [W30] '{U 19}~
A:AU7: [W21] 'OPTION2 MACRO
A:AV7: [W30] '{HOME}~
A:AV8: [W30] '{D 79}~
A:AV9: [W30] '{U 19}~
A:AU11: [W21] 'OPTION3 MACRO
A:AV11: [W30] '{HOME}~
A:AV12: [W30] '{D 119}~
A:AV13: [W30] '{U 19}~
A:AU15: [W21] 'OPTION4 MACRO
A:AV15: [W30] '{HOME}~
A:AV16: [W30] '{D 159}~
```

```
A:AV17: [W30] '{U 19}~
A:AU19: [W21] 'OPTION5 MACRO
A:AV19: [W30] '{HOME}~
A:AV20: [W30] '{R 49}~
A:AV21: [W30] '{L 3}~
A:AU23: [W21] 'OPTION6 MACRO
A:AV23: [W30] '{HOME}~
A:AV24: [W30] '{R 1}~
A:AU26: [W21] 'OPTION7 MACRO
A:AV26: [W30] '{HOME}~
A:AV27: [W30] '{R 2}~
A:AU29: [W21] 'OPTION8 MACRO
A:AV29: [W30] '{HOME}~
A:AV30: [W30] '{R 3}~
A:AU32: [W21] 'OPTION9 MACRO
A:AV32: [W30] '{HOME}~
A:AV33: [W30] '{R 4}~
A:AU35: [W21] 'OPTION10 MACRO
A:AV35: [W30] '{HOME}~
A:AV36: [W30] '{R 5}~
A:AU38: [W21] 'OPTION11 MACRO
A:AV38: [W30] '{HOME}~
A:AV39: [W30] '{R 6}~
A:AU41: [W21] 'OPTION12 MACRO
A:AV41: [W30] '{HOME}~
A:AV42: [W30] '{R 7}~
A:AU44: [W21] 'OPTION13 MACRO
A:AV44: [W30] '{HOME}~
A:AV45: [W30] '{R 8}~
A:AU47: [W21] 'OPTION14 MACRO
A:AV47: [W30] '{HOME}~
A:AV48: [W30] '{R 9}~
A:AU50: [W21] 'OPTION15 MACRO
A:AV50: [W30] '{HOME}~
A:AV51: [W30] '{D 59}~
A:AV52: [W30] '{U 19}~
A:AU54: [W21] 'OPTION16 MACRO
A:AV54: [W30] '{HOME}~
A:AV55: [W30] '{R 10}~
A:AU57: [W21] 'OPTION17 MACRO
A:AV57: [W30] '{HOME}~
A:AV58: [W30] '{R 11}~
A:AU60: [W21] 'OPTION18 MACRO
A:AV60: [W30] '{HOME}~
A:AV61: [W30] '{R 12}~
A:AU63: [W21] 'OPTION19 MACRO
A:AV63: [W30] '{HOME}~
A:AV64: [W30] '{R 13}~
A:AU66: [W21] 'OPTION20 MACRO
```

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A:AV66: [W30] '{HOME}~
A:AV67: [W30] '{R 14}~
A:AU69: [W21] 'OPTION21 MACRO
A:AV69: [W30] '{HOME}~
A:AV70: [W30] '{R 15}~
A:AU72: [W21] 'OPTION22 MACRO
A:AV72: [W30] '{HOME}~
A:AV73: [W30] '{R 16}~
A:AU75: [W21] 'OPTION23 MACRO
A:AV75: [W30] '{HOME}~
A:AV76: [W30] '{R 17}~
A:AU78: [W21] 'OPTION24 MACRO
A:AV78: [W30] '{HOME}~
A:AV79: [W30] '{R 18}~
A:AU81: [W21] 'OPTION25 MACRO
A:AV81: [W30] '{HOME}~
A:AV82: [W30] '{R 19}~
A:AU84: [W21] 'OPTION26 MACRO
A:AV84: [W30] '{HOME}~
A:AV85: [W30] '{R 20}~
A:AU87: [W21] 'OPTION27 MACRO
A:AV87: [W30] '{HOME}~
A:AV88: [W30] '{R 21}~
A:AU90: [W21] 'OPTION28 MACRO
A:AV90: [W30] '{HOME}~
A:AV91: [W30] '{R 22}~
A:AU93: [W21] 'OPTION29 MACRO
A:AV93: [W30] '{HOME}~
A:AV94: [W30] '{R 23}~
A:AU96: [W21] 'OPTION30 MACRO
A:AV96: [W30] '{HOME}~
A:AV97: [W30] '{R 24}~
A:AU99: [W21] 'OPTION31 MACRO
A:AV99: [W30] '{HOME}~
A:AV100: [W30] '{R 25}~
A:AU102: [W21] 'OPTION32 MACRO
A:AV102: [W30] '{HOME}~
A:AV103: [W30] '{R 26}~
A:AU105: [W21] 'OPTION33 MACRO
A:AV105: [W30] '{HOME}~
A:AV106: [W30] '{R 27}~
A:AU108: [W21] 'OPTION34 MACRO
A:AV108: [W30] '{HOME}~
A:AV109: [W30] '{D 79}~
A:AV110: [W30] '{U 19}~
A:AU112: [W21] 'OPTION35 MACRO
A:AV112: [W30] '{HOME}~
A:AV113: [W30] '{R 28}~
A:AU115: [W21] 'OPTION36 MACRO
```

```
A:AV115: [W30] '{HOME}~
A:AV116: [W30] '{R 29}~
A:AU118: [W21] 'OPTION37 MACRO
A:AV118: [W30] '{HOME}~
A:AV119: [W30] '{R 30}~
A:AU121: [W21] 'OPTION38 MACRO
A:AV121: [W30] '{HOME}~
A:AV122: [W30] '{R 31}~
A:AU124: [W21] 'OPTION39 MACRO
A:AV124: [W30] '{HOME}~
A:AV125: [W30] '{R 32}~
A:AU127: [W21] 'OPTION40 MACRO
A:AV127: [W30] '{HOME}~
A:AV128: [W30] '{R 33}~
A:AU130: [W21] 'OPTION41 MACRO
A:AV130: [W30] '{HOME}~
A:AV131: [W30] '{R 34}~
A:AU133: [W21] 'OPTION42 MACRO
A:AV133: [W30] '{HOME}~
A:AV134: [W30] '{R 35}~
A:AU136: [W21] 'OPTION43 MACRO
A:AV136: [W30] '{HOME}~
A:AV137: [W30] '{R 36}~
A:AU139: [W21] 'OPTION44 MACRO
A:AV139: [W30] '{HOME}~
A:AV140: [W30] '{R 37}~
A:AU142: [W21] 'OPTION45 MACRO
A:AV142: [W30] '{HOME}~
A:AV143: [W30] '{R 38}~
A:AU145: [W21] 'OPTION46 MACRO
A:AV145: [W30] '{HOME}~
A:AV146: [W30] '{R 39}~
A:AU148: [W21] 'OPTION47 MACRO
A:AV148: [W30] '{HOME}~
A:AV149: [W30] '{R 40}~
A:AU151: [W21] 'OPTION48 MACRO
A:AV151: [W30] '{HOME}~
A:AV152: [W30] '{R 41}~
A:AU154: [W21] 'OPTION49 MACRO
A:AV154: [W30] '{HOME}~
A:AV155: [W30] '{D 119}~
A:AV156: [W30] '{U 19}~
A:AU158: [W21] 'OPTION50 MACRO
A:AV158: [W30] '{HOME}~
A:AV159: [W30] '{R 42}~
A:AU161: [W21] 'OPTION51 MACRO
A:AV161: [W30] '{HOME}~
A:AV162: [W30] '{R 43}~
A:AU164: [W21] 'OPTION52 MACRO
```

```
A:AV164: [W30] '{HOME}~
A:AV165: [W30] '{R 44}~
A:AU167: [W21] 'OPTION53 MACRO
A:AV167: [W30] '{HOME}~
A:AV168: [W30] '{R 45}~
```

T. **MODULE6.WK3**

```
A:A1: [W9] 'CATEGORY
A:B1: [W9] 'LOCATION
A:C1: [W9] 'SRCUFT
A:D1: [W9] 'LOCCUFT
A:E1: [W9] 'ONE/FR/1
A:F1: [W9] 'SRL
A:G1: [W9] 'SRW
A:H1: [W9] 'SRH
A:I1: [W9] 'SR UTIL
A:J1: [W9] 'LOCL
A:K1: [W9] 'LOCW
A:L1: [W9] 'LOCH
A:M1: [W9] 'PACK FAC
A:A2: [W9] SHIP'S OWN USE (JRCKS = J RACK SHELF, SBIND =
S BIN DRAWER)
A:B2: [W9] MANUAL ENTRY FOR STOREROOM (280000, 320000):
USED IN CONJUNCTION WITH MANUAL ENTRIES F2, G2, H2, I2
TO COMPUTE C2
A:C2: [W9] {F0} +F2*G2*H2*I2
A:F2: [W9] MANUAL ENTRY:  STOREROOM LENGTH
A:G2: [W9] MANUAL ENTRY:  STOREROOM WIDTH
A:H2: [W9] MANUAL ENTRY:  STOREROOM HEIGHT
A:I2: [W9] MANUAL ENTRY:  STOREROOM UTILIZATION (.5,
.35, .3)
A:B3: [W9] MANUAL ENTRY FOR STOREROOM (280000, 320000):
USED IN CONJUNCTION WITH MANUAL ENTRIES J4, K4, L4 M4 TO
COMPUTE D4
A:B4: [W9] MANUAL ENTRY FOR LOCATION WITHIN A STOREROOM
(320001, 320002)
A:D4: [W9] {F0} +J4*K4*L4*M4
A:J4: [W9] MANUAL ENTRY:  LOCATION LENGTH
A:K4: [W9] MANUAL ENTRY:  LOCATION WIDTH
A:L4: [W9] MANUAL ENTRY:  LOCATION HEIGHT
A:M4: [W9] MANUAL ENTRY:  PACKING FACTOR (.7, .65, .6)
A:B5: [W9] MANUAL ENTRY FOR A LOCKER WITH A FIXED NUMBER
OF ONE-FOR-ONE LOCATIONS (GS1400, 140LKR):  ENTER TOTAL
NUMBER OF ONE-FOR-ONE LOCATIONS IN E2
A:E5: [W9] MANUAL ENTRY:  NUMBER OF POSITIONS WITHIN THE
LOCKER
```

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